IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

LG DISPLAY CO., LTD., Plaintiff, v. AU OPTRONICS CORPORATION; AU OPTRONICS CORPORATION AMERICA; CHI MEI OPTOELECTRONICS CORPORATION, and CHI MEI OPTOELECTRONICS USA, INC., Defendants.	Civil Action No. 06-726 (JJF)
AU OPTRONICS CORPORATION, Plaintiff, v. LG DISPLAY CO., LTD. and LG DISPLAY AMERICA, INC., Defendants.	Civil Action No. 07-357 (JJF) **CONSOLIDATED CASES**
LG DISPLAY CO., LTD., Plaintiff, v. CHI MEI OPTOELECTRONICS CORPORATION, et al., Defendants.	Civil Action No. 06-726 (JJF) Civil Action No. 07-357 (JJF) CONSOLIDATED CASES

DECLARATION OF HUA CHEN
IN SUPPORT OF AUO'S OPENING CLAIM CONSTRUCTION BRIEF

I, Hua Chen, declare as follows:

1. I am an attorney duly admitted to practice before all the courts of the State of California, and also admitted to practice pro hac vice before this Court. I am an attorney

with the law firm of Paul, Hastings, Janofsky & Walker LLP, counsel of record for Defendants Au Optronics Corporation and Au Optronics Corporation America (collectively "AUO"). I have personal knowledge of the facts declared herein, and if called as a witness, could and would competently testify thereto.

2. I make this Declaration in support of AUO's Opening Claim Construction Brief.

3. Attached hereto as Exhibit "1" is a true and correct copy of selected pages from THE RANDOM HOUSE DICTIONARY OF THE ENGLISH LANGUAGE (2nd Ed. 1987).

4. Attached hereto as Exhibit "2" is a true and correct copy of U.S. Patent No. 4,820,222, issued to S. Holmberg et al. on April 11, 1989.

5. Attached hereto as Exhibit "3" is a true and correct copy of the claim construction opinion issued by Judge J. Farnan on or about June 13, 2006 in *LG. Philips LCD Co., Ltd.* v. *Tatung Company et al.*, No. 05-292 (JJF) (Del., filed on May 13, 2005) (the "Judge Farnan Memorandum Opinion"). The Judge Farnan Memorandum Opinion addressed certain claim terms and limitation of U.S. Patent No. 5,825,449.

6. Attached hereto as Exhibit "4" is a true and correct copy of selected pages from THE AUTHORITATIVE DICTIONARY OF IEEE STANDARDS TERMS (4th Ed. 1988).

7. Attached hereto as Exhibit "5" is a true and correct copy of selected pages from RANDOM HOUSE WEBSTER'S COLLEGE DICTIONARY (2nd Ed. 1997).

8. Attached hereto as Exhibit "6" is a true and correct copy of U.S. Patent No. 5,156,986, issued to C. Wei et al. on October 20, 1992 (the "Wei" Reference).

9. Attached hereto as Exhibit "7" is a true and correct copy of U.S. Patent No. 5,036,370, issued to M. Miyago et al. on July 30, 1991 (the "Miyago" Reference).

10. Attached hereto as Exhibit "8" is a true and correct copy of selected pages from the file history of U.S. Patent No. 6,573,127.

11. Attached hereto as Exhibit "9" is a true and correct copy of U.S. Patent No. 7,075,595, issued to H. Moon et al. on July 11, 2006.

12. Attached hereto as Exhibit "10" is a true and correct copy of selected pages from THE AMERICAN HERITAGE DICTIONARY OF THE ENGLISH LANGUAGE (4th Ed. 2000).

13. Attached hereto as Exhibit "11" is a true and correct copy of selected pages from RANDOM HOUSE WEBSTER'S UNABRIDGED DICTIONARY (2nd Ed. 2001).

14. Attached hereto as Exhibit "12" is a true and correct copy of Japanese patent reference No. 8-171076, along with its English abstract. A copy of the same was included in the file history for U.S. Patent No. 6,803,984.

15. Attached hereto as Exhibit "13" is a true and correct copy of selected pages from THE OXFORD AMERICAN COLLEGE DICTIONARY (2002).

I hereby declare under penalty of perjury under the laws of the United States of America that the matters declared herein are true and correct, and that this declaration is executed this 11th day of August, 2008, at Los Angeles, California.

By _____
Hua Chen

CERTIFICATE OF SERVICE

I, Andrew A. Lundgren, Esquire, hereby certify that on August 11, 2008, I caused to be electronically filed a true and correct copy of the foregoing document with the Clerk of the Court using CM/ECF, which will send notification that such filing is available for viewing and downloading to the following counsel of record:

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EXHIBIT 1

THE RANDOM HOUSE DICTIONARY OF THE ENGLISH LANGUAGE

Second Edition

Unabridged

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r.s/uh

de·po·lym·er·ize (dē′pə lim′ə rīz′, dē pol′ə mə-), *v.t.*, **-ized, -iz·ing.** *Chem.* to break down (a polymer) into monomers. Also, *esp. Brit.*, **de/po·lym′er·ise′.** [1890–95; DE- + POLYMERIZE] —**de/po·lym′er·i·za′tion,** *n.*

de·pone (di pōn′), *v.t., v.i.*, **-poned, -pon·ing.** to testify under oath; depose. [1525–35; < L *dēpōnere* to put away, down, aside (ML: to testify), equiv. to *dē-* DE- + *pōnere* to put]

de·po·nent (di pō′nənt), *adj.* **1.** *Class. Gk. and Latin Gram.* (of a verb) appearing only in the passive or Greek middle-voice forms, but with active meaning. —*n.* **2.** *Law.* a person who testifies under oath, esp. in writing. **3.** *Class. Gk. and Latin Gram.* a deponent verb, as Latin *loquor.* [1520–30; < L *dēpōnent-* (s. of *dēpōnēns*) putting away (ML: testifying), prp. of *dēpōnere.* See DEPONE, -ENT]

Dep·o-Pro·ve·ra (dep′ō prō vâr′ə), *Pharm., Trademark.* a brand of medroxyprogesterone.

de·pop·u·late (*v.* dē pop′yə lāt′; *adj.* dē pop′yə lit, -lāt′), *v.*, **-lat·ed, -lat·ing,** *adj.* —*v.t.* **1.** to remove or reduce the population of, as by destruction or expulsion. —*adj.* **2.** *Archaic.* depopulated. [1525–35; < L —*adj.* **2.** *Archaic.* depopulated. [1525–35; < L *dēpopulātus* devastated (ptp. of *dēpopulārī*), equiv. to *dē-* DE- + *populātus*; see POPULATE] —**de·pop′u·la′tion,** *n.* —**de·pop′u·la′tive,** *adj.* —**de·pop′u·la′tor,** *n.*

de·port (di pôrt′, -pōrt′), *v.t.* **1.** to expel (an alien) from a country; banish. **2.** to send or carry off; transport, esp. forcibly: *The country deported its criminals.* **3.** to bear, conduct, or behave (oneself) in a particular manner. [1475–85; < MF *déporter* < L *dēportāre* to carry away, banish oneself, equiv. to *dē-* DE- + *portāre* to carry; see PORT⁵] —**de·port′a·ble,** *adj.* —**de′por·tee′,** *n.* —**de·port′er,** *n.*

de·por·ta·tion (dē′pôr tā′shən, -pōr-), *n.* **1.** the lawful expulsion of an undesired alien or other person from a state. **2.** an act or instance of deporting. [1585–95; < L *dēportātiōn-* (s. of *dēportātiō*), equiv. to *dēportāt(us)* (ptp. of *dēportāre*; see DEPORT, -ATE¹) + *-iōn-* -ION]

de·port·ment (di pôrt′mənt, -pōrt′-), *n.* **1.** demeanor; conduct; behavior. **2.** the conduct or obedience of a child in school, as graded by a teacher. [1595–1605; < F *déportement*, equiv. to *déporte(r)* (see DEPORT) + *-ment* -MENT]
—**Syn.** See **behavior.**

de·pos·al (di pō′zəl), *n.* an act of deposing. [1350–1400; ME; see DEPOSE, -AL²]

de·pose (di pōz′), *v.*, **-posed, -pos·ing.** —*v.t.* **1.** to remove from office or position, esp. high office: *The people deposed the dictator.* **2.** to testify or affirm under oath, esp. in a written statement: *to depose that it was true.* —*v.i.* **3.** to give sworn testimony, esp. in writing. [1250–1300; ME *deposen* < OF *depuser* to put down, equiv. to *de-* DE- + *poser* < VL **posāre*, LL *pausāre*; see POSE¹] —**de·pos′a·ble,** *adj.*. —**de·pos′er,** *n.*

de·pos·it (di poz′it), *v.t.* **1.** to place for safekeeping or in trust, esp. in a bank account: *He deposited his paycheck every Friday.* **2.** to give as security or in part payment. **3.** to deliver and leave (an item): *Please deposit your returned books with the librarian.* **4.** to insert (a coin) in a coin-operated device: *Deposit a quarter and push the button.* **5.** to put, place, or set down, esp. carefully or exactly: *She deposited the baby in the crib.* **6.** to lay or throw down by a natural process; precipitate: *The river deposited soil at its mouth.* —*v.i.* **7.** to be placed, inserted, precipitated, left for safekeeping, given as security or in partial payment, etc. —*n.* **8.** money placed in a bank account or an instance of placing money in a bank account. **9.** anything given as security or in part payment: *The boy returned the bottle and got his five-cent deposit back. They made a deposit on the house and signed a ten-year mortgage.* **10.** anything laid away or entrusted to another for safekeeping: *A large deposit of jewels was stolen from the hotel safe.* **11.** a place for safekeeping; depository. **12.** something precipitated, delivered and left, or thrown down, as by a natural process: *a deposit of soil.* **13.** the natural sediment of wine in a bottle. **14.** a coating of metal deposited on something, usually by an electric current. **15.** a natural accumulation or occurrence, esp. of oil or ore: *a mountain range with many rich deposits of gold.* [1615–25; < L *dēpositus* laid down, ptp. of *dēpōnere*; see DEPONE]
—**Syn. 1.** bank, save, store. **15.** lode, vein, pocket.

de·pos·i·tar·y (di poz′i ter′ē), *n., pl.* **-tar·ies.** **1.** one to whom anything is given in trust. **2.** depository (def. 1). [1595–1605; < L *dēpositārius* a trustee, equiv. to *dēposit(us)* (see DEPOSIT) + *-ārius* -ARY]

de·po·si·tion (dep′ə zish′ən, dē′pə-), *n.* **1.** removal from an office or position. **2.** the act or process of depositing: *deposition of the documents with the Library of Congress.* **3.** the state of being deposited or precipitated: *deposition of soil at the mouth of a river.* **4.** something that is deposited. **5.** *Law.* **a.** the giving of testimony under oath. **b.** the testimony so given. **c.** a statement under oath, taken down in writing, to be used in court in place of the spoken testimony of the witness. **6.** *Eccles.* **a.** the interment of the body of a saint. **b.** the reinterment of the body or the relics of a saint. **7.** (*cap.*) a work of art depicting Christ being lowered from the Cross. [1350–1400; ME (< AF) < LL *dēpositiōn-* (s. of *dēpositiō*) a putting aside, testimony, burial, equiv. to L *dēposit(us)* laid down (see DEPOSIT) + *-iōn-* -ION] —**de·pos′i·tion·al,** *adj.*

de·pos′it mon′ey, *Banking.* checks, letters of credit, etc., that circulate and are payable on demand. [1815–25]

de·pos·i·tor (di poz′i tər), *n.* **1.** a person or thing that deposits. **2.** a person who deposits money in a bank or who has a bank account. [1555–65; < LL, equiv. to L *dēposi-*, var. s. of *dēpōnere* (see DEPONE) + *-tor* -TOR]

de·pos·i·to·ry (di poz′i tôr′ē, -tōr′ē), *n., pl.* **-ries.** **1.** a place where something is deposited or stored, as for safekeeping: *the night depository of a bank.* **2.** a depositary; trustee. —*adj.* **3.** of or pertaining to a depository or depositories: *the depository role of a bank.* [1650–60; (def. 1) < ML *dēpositōrium*; (def. 2) DEPOSIT + -ORY¹ (n. use of adj. suffix)]

depos′itory li′brary, a library designated by law to receive without charge all or a selection of the official publications of a government. [1925–30]

depos′it slip′, a slip for listing deposits made to a bank account. Also called **credit slip.** [1900–05]

de·pot (dē′pō; *Mil. or Brit.* dep′ō), *n.* **1.** a railroad station. **2.** a bus station. **3.** *Mil.* **a.** a place in which supplies and materials are stored for distribution. **b.** (formerly) a place where recruits are assembled for classification, initial training, and assignment to active units. **4.** a storehouse or warehouse, as a building where freight is deposited. **5.** *Physiol.* a place where body products not actively involved in metabolic processes are accumulated, deposited, or stored. [1785–95; < F *dépot* < L *dēpositum*, n. use of neut. of *dēpositus*; see DEPOSIT]
—**Syn. 1, 2.** terminal.

depr., **1.** depreciation. **2.** depression.

de·prave (di prāv′), *v.t.*, **-praved, -prav·ing.** **1.** to make morally bad or evil; vitiate; corrupt. **2.** *Obs.* to defame. [1325–75; ME *depraven* (< AF) < L *dēprāvāre* to pervert, corrupt, equiv. to *dē-* DE- + *prāv(us)* crooked + *-āre* inf. suffix] —**de·pra·va·tion** (dep′rə vā′shən), *n.* —**de·prav′er,** *n.* —**de·prav′ing·ly,** *adv.*

de·praved (di prāvd′), *adj.* corrupt, wicked, or perverted. [1585–95; DEPRAVE + -ED²] —**de·praved·ly** (di prāvd′lē, -prā′vid-), *adv.* —**de·praved′ness,** *n.*
—**Syn.** evil, sinful, debased, reprobate, degenerate; dissolute, profligate; licentious, lewd. See **immoral.**

de·prav·i·ty (di prav′i tē), *n., pl.* **-ties.** for 2. **1.** the state of being depraved. **2.** a depraved act or practice. [1635–45; DEPRAVE + -ITY]

dep·re·cate (dep′ri kāt′), *v.t.*, **-cat·ed, -cat·ing.** **1.** to express earnest disapproval of. **2.** to urge reasons against; protest against (a scheme, purpose, etc.). **3.** to depreciate; belittle. **4.** *Archaic.* to pray for deliverance from. [1615–25; < L *dēprecātus* prayed against, warded off (ptp. of *dēprecārī*), equiv. to *dē-* DE- + prec(ārī) to pray + *-ātus* -ATE¹] —**dep′re·cat′ing·ly,** *adv.* —**dep′re·ca′tion,** *n.* —**dep′re·ca′tor,** *n.*
—**Syn. 1.** condemn, denounce, disparage. See **decry.**
—**Usage.** An early and still the most current sense of DEPRECATE is "to express disapproval of." In a sense DEPRECATE is "to express disapproval of." In a sense development still occasionally criticized by a few, DEPRECATE has come to be synonymous with the similar but etymologically unrelated word DEPRECIATE in the sense "belittle": *The author modestly deprecated the importance of his work.* In compounds with *self-*, DEPRECATE has almost totally replaced DEPRECIATE in modern usage: *Her self-deprecating account of her career both amused and charmed the audience.*

dep·re·ca·tive (dep′ri kā′tiv, -kə tiv), *adj.* serving to deprecate; depracatory. [1480–90; (< AF) < LL *dēprecātīvus*, equiv. to *dēprecāt(us)* (see DEPRECATE) + *-īvus* -IVE] —**dep′re·ca′tive·ly,** *adv.*

dep·re·ca·to·ry (dep′ri kə tôr′ē, -tōr′ē), *adj.* **1.** of the nature of or expressing disapproval, protest, or deprecation. **2.** apologetic; making apology. [1580–90; < LL *dēprecātōrius*, equiv. to L *dēprecā(rī)* (see DEPRECATE) + *-tōrius* -TORY¹] —**dep′re·ca·to·ri·ly,** *adv.* —**dep′re·ca·to·ri·ness,** *n.*

de·pre·ci·a·ble (di prē′shē ə bəl, -shə bəl), *adj.* **1.** capable of depreciating or being depreciated in value. **2.** capable of being depreciated for tax purposes. [DEPRECIATE + -ABLE]

de·pre·ci·ate (di prē′shē āt′), *v.*, **-at·ed, -at·ing.** —*v.t.* **1.** to reduce the purchasing value of (money). **2.** on (a property) for tax purposes. **4.** to represent as of little value or merit; belittle. —*v.i.* **5.** to decline in value. [1640–50; < LL *dēpretiātus* undervalued (ptp. of *dēpretiāre*, in ML sp. *dēpreciāre*), equiv. to L *dē-* DE- + *preti(um)* PRICE + *-ātus* -ATE¹] —**de·pre′ci·at′ing·ly,** *adv.* —**de·pre′ci·a′tor,** *n.*
—**Syn. 4.** disparage, decry, minimize.
—**Usage. 4.** See **deprecate.**

de·pre·ci·a·tion (di prē′shē ā′shən), *n.* **1.** decrease in value due to wear and tear, decay, decline in price, etc. **2.** such a decrease as allowed in computing the value of property for tax purposes. **3.** a decrease in the purchasing or exchange value of money. **4.** a lowering in estimation. [1730–40, *Amer.*; DEPRECIATE + -ION]

de·pre·ci·a·to·ry (di prē′shē ə tôr′ē, -tōr′ē, -prē′shə-), *adj.* tending to depreciate. Also, **de·pre·ci·a·tive** (di prē′shē ā′tiv, -shə tiv). [1795–1805; DEPRECIATE + -ORY¹] —**de·pre′ci·a·tive·ly,** *adv.*

dep·re·date (dep′ri dāt′), *v.*, **-dat·ed, -dat·ing.** —*v.t.* **1.** to plunder or lay waste to; prey upon; pillage; ravage. —*v.i.* **2.** to plunder; pillage. [1620–30; < LL *dēpraedātus* plundered (ptp. of *depraedārī*), equiv. to L *dē-* DE- + *praed(ārī)* to plunder (see PREY) + *-ātus* -ATE¹] —**dep′re·da′tor,** *n.* —**dep′re·da·to·ry** (dep′ri dā′tə rē, -pred′ə tôr′ē, -tōr′ē), *adj.*

dep·re·da·tion (dep′ri dā′shən), *n.* the act of preying upon or plundering; robbery; ravage. [1475–85; < LL *dēpraedātiōn-* (s. of *dēpraedātiō*) a plundering, equiv. to *dēpraedāt(us)* (see DEPREDATE) + *-iōn-* -ION] —**dep′re·da′tion·ist,** *n.*

de·press (di pres′), *v.t.* **1.** to make sad or gloomy; lower in spirits; deject; dispirit. **2.** to lower in force, vigor, activity, etc.; weaken; make dull. **3.** to lower in amount or value. **4.** to put into a lower position: *to depress the muzzle of a gun.* **5.** to press down. **6.** *Music.* to lower in pitch. [1275–1325; ME *depressen* < AF, OF *depresser* < L *dēpressus* pressed down (ptp. of *dēprimere*, equiv. to *de-* DE- + *-primere*, comb. form of *premere* to press); see PRESSURE] —**de·press′i·ble,** *adj.* —**de·press′i·bil′i·ty,** *n.*
—**Syn. 1.** dishearten, discourage, sadden. See **oppress. 3.** devalue, cheapen. —**Ant. 4.** raise, elevate.

de·pres·sant (di pres′ənt), *adj.* **1.** *Med.* having the quality of depressing or lowering the vital activities; sedative. **2.** causing a lowering in spirits; dejecting. **3.** causing a drop in value; economically depressing. —*n.* **4.** *Med.* a sedative. Cf. **stimulant** (def. 1). **5.** *Ch* agent capable of diminishing a specific property c stance. [1875–80; DEPRESS + -ANT]

de·pressed (di prest′), *adj.* **1.** sad and gloo jected; downcast. **2.** pressed down, or situate than the general surface. **3.** lowered in force, etc. **4.** undergoing economic hardship, esp. pove unemployment. **5.** being or measured below the ard or norm. **6.** *Bot., Zool.* flattened down; gr width than in height. **7.** *Psychiatry.* suffering f pression. [1375–1425; late ME; see DEPRESS, -ED²]
—**Syn. 1.** saddened, morose, despondent, mi blue; morbid. —**Ant. 1.** happy.

depressed′ ar′ea, a region where unempl and a low standard of living prevail. [1925–30]

de·press·ing (di pres′ing), *adj.* serving to depr ducing a state of depression: *depressing news.* [DEPRESS + -ING²] —**de·press′ing·ly,** *adv.*

de·pres·sion (di presh′ən), *n.* **1.** the act of ing. **2.** the state of being depressed. **3.** a depre sunken place or part; an area lower than the su ing surface. **4.** sadness; gloom; dejection. **5.** *Psy* a condition of general emotional dejection an drawal; sadness greater and more prolonged th warranted by any objective reason. Cf. **clinical sion. 6.** dullness or inactivity, as of trade. **7.** period during which business, employment, and market values decline severely or remain at a v level of activity. **8. the Depression.** See **Great sion. 9.** *Pathol.* a low state of vital powers or fu activity. **10.** *Astron.* the angular distance of a body below the horizon; negative altitude. **11.** the angle between the line from an observer or ment to an object below either of them and a ho line. **12.** *Phys. Geog.* an area completely or mos rounded by higher land, ordinarily having drainage and not conforming to the valley of stream. **13.** *Meteorol.* an area of low atmospher sure. [1350–1400; ME (< AF) < ML *dēpressiōn* (*dēpressiō*), LL; a pressing down, equiv. to L *dēp* (see DEPRESS) + *-iōn-* -ION]
—**Syn. 4.** discouragement, despondency.

Depres′sion glass′, inexpensive, machine-p usually translucent glassware, including dis vases, etc., mass-produced in the U.S. from t 1920's to the 1940's and often used as giveaway induce customers to buy goods or movie tickets.

de·pres·sive (di pres′iv), *adj.* **1.** tending to d **2.** characterized by depression, esp. mental dep —*n.* **3.** a person suffering from a depressive [1610–20; DEPRESS + -IVE] —**de·pres′sive·ly,** —**de·pres′sive·ness,** *n.*

de·pres·so·mo·tor (di pres′ō mō′tər), *adj. Med.* causing a retardation of motor activity: *motor nerves.* [DEPRESS + -O- + MOTOR]

de·pres·sor (di pres′ər), *n.* **1.** a person or thi depresses. **2.** *Surg.* an instrument for pressing protruding part, as a tongue depressor. **3.** *Ana* muscle that draws down a part of the body, as the of the mouth. Cf. **levator. b.** Also called **depr nerve.** a nerve that, when stimulated, induces crease in activity, as a slowed heartbeat. [1605 LL, deriv. of L *dēprimere* (see DEPRESS, -TOR)]

de·pres·sur·ize (dē presh′ə rīz′), *v.*, **-ized,** —*v.t.* **1.** to remove the air pressure from (a pres compartment of an aircraft or spacecraft). **2.** to the tensions of; cause to relax: *A week's vacation depressurize me.* —*v.i.* **3.** to lose air pressure: *T plane cabin depressurized almost instantly.* Als *Brit.*, **de·pres′sur·ise′.** [1940–45; DE- + PRES —**de·pres′sur·i·za′tion,** *n.* —**de·pres′sur·iz′er,**

dep·ri·va·tion (dep′rə vā′shən), *n.* **1.** the act priving. **2.** the fact of being deprived. **3.** disposse loss. **4.** removal from ecclesiastical office. **5.** pri [1525–35; < ML *dēprīvātiōn-* (s. of *dēprīvātiō*), eq *dēprīvāt(us)* deprived (ptp. of *dēprīvāre*; see DE -ATE¹) + *-iōn-* -ION]

de·prive (di prīv′), *v.t.*, **-prived, -priv·ing.** **1.** move or withhold something from the enjoyment session of (a person or persons): *to deprive a man to deprive a baby of candy.* **2.** to remove from ecc tical office. [1275–1325; ME *deprīven* < AF, OF *d* < ML *dēprīvāre*, equiv. to L *dē-* DE- + *prīvāre* prive (*prīv(us)* PRIVATE + *-āre* inf. suffix)] —**de·p ble,** *adj.* —**de·priv′al,** *n.* —**de·priv′a·tive** (di tiv), *adj.* —**de·priv′er,** *n.*
—**Syn. 1.** See **strip.**

de·prived (di prīvd′), *adj.* marked by depri lacking the necessities of life, as adequate food an ter: *a deprived childhood.* [1545–55; DEPRIVE + -

de·pro·fes·sion·al·ize (dē′prə fesh′ə nl īz′ **-ized, -iz·ing.** **1.** to remove from professional influence, manipulation, etc. **2.** to cause to app become unprofessional; discredit or deprive of sional status: *a campaign to deprofessionalize t tion's doctors.* Also, *esp. Brit.*, **de/pro·fes′sion·** [1880–85; DE- + PROFESSIONALIZE]

de pro·fun·dis (dā prō fo͝on′dis), *Latin.* out depths (of sorrow, despair, etc.).

de·pro·gram (dē prō′gram), *v.t.*, **-gramm -gramed, -gram·ming** or **-gram·ing.** **1.** to free vert) from the influence of a religious cult, politi doctrination, etc., by intensive persuasion or reedu **2.** to retrain, as for the purpose of eliminating or ing a learned or acquired behavior pattern or hab is undesirable or unsuitable. [1970–75, *Amer.*; PROGRAM] —**de·pro′gram·mer, de·pro′gram·er**

dep·side (dep′sīd, -sid), *n. Chem.* any of a gr

experimentally in order to test its value. —*v.i.* **14.** to search or explore a region for gold or the like. [1400–50; late ME *prospecte* < L *prōspectus* outlook, view. See PROSPECTUS] —**pros′pect·less,** *adj.* —**pros·pec′tor** (pros′pek tər, prə spek′tər), *n.*

—**Syn. 6, 7.** See **view. 7, 8.** perspective.

Pros′pect Heights′, a town in N Illinois. 11,808.

pro·spec·tive (prə spek′tiv), *adj.* **1.** of or in the future: *prospective earnings.* **2.** potential, likely, or expected: *a prospective partner.* [1580–90; < LL *prōspectīvus.* See PROSPECTUS, -IVE] —**pro·spec′tive·ly,** *adv.* —**pro·spec′tive·ness,** *n.*

pro·spec·tus (prə spek′təs), *n., pl.* **-tus·es. 1.** a document describing the major features of a proposed literary work, project, business venture, etc., in enough detail so that prospective investors, participants, or buyers may evaluate it: *Don't buy the new stock offering until you read the prospectus carefully.* **2.** a brochure or other document describing the major features, attractions, or services of a place, institution, or business to prospective patrons, clients, owners, or members. [1770–80; < L *prōspectus* outlook, view, equiv. to *prōspec-,* s. of *prōspicere* (prō- PRO-[1] + -*spicere,* comb. form of *specere* to look) + -*tus* suffix of *v.* action]

pros·per (pros′pər), *v.i.* **1.** to be successful or fortunate, esp. in financial respects; thrive; flourish. —*v.t.* **2.** *Archaic.* to make successful or fortunate. [1425–75; late ME *prosperen* < L *prosperāre* to make happy, deriv. of *prosperus* PROSPEROUS]

—**Syn. 1.** See **succeed.** —**Ant. 1.** fail.

pros·per·i·ty (pro sper′i tē), *n., pl.* **-ties. 1.** a successful, flourishing, or thriving condition, esp. in financial respects; good fortune. **2. prosperities,** prosperous circumstances. [1175–1225; ME *prosperite* < OF < L *prosperitās.* See PROSPEROUS, -ITY]

Pros·per·o (pros′pə rō′), *n.* (in Shakespeare's *The Tempest*) the exiled Duke of Milan, who is a magician.

pros·per·ous (pros′pər əs), *adj.* **1.** having or characterized by financial success or good fortune; flourishing; successful: *a prosperous business.* **2.** well-to-do or well-off: *a prosperous family.* **3.** favorable or propitious. [1400–50; late ME < L *prosperus*] —**pros′per·ous·ly,** *adv.* —**pros′per·ous·ness,** *n.*

—**Syn. 1.** thriving. **2.** wealthy, rich. **3.** fortunate, lucky, auspicious.

pros·pho·ra (*Gk.* prōs′fō rä; *Eng.* pros′fō rə′, -fər ə), *n. Eastern Ch.* antidoron. [1870–75; < Gk *prosphorá* an offering, lit., a bringing to, applying, equiv. to *pros-* toward + *phorá* something carried (verbid of *phérein* to bring)]

pros·pho·ron (*Gk.* prōs′fō rōn; *Eng.* pros′fə ron′, -fər ən), *n. Eastern Ch.* an uncut loaf of altar bread before it is consecrated. [< Gk *prósphoron,* n. use of neut. of *prósphoros* useful, fitting, deriv. of *prosphorá* PROSPHORA]

pross[1] (pros), *v.i. Scot. and North Eng.* to exhibit pride or haughtiness; put on airs. [perh. Scots var., in v. use, of PROWESS] —**pross′y,** *adj.*

pross[2] (pros), *n. Slang.* prostitute. [by shortening and resp.]

Pros·ser (pros′ər), *n.* **Gabriel,** 1775?–1800, U.S. leader of unsuccessful slave revolt.

prost (prōst), *interj.* prosit. [by contr.]

pros·ta·cy·clin (pros′tə sī′klin), *n. Biochem.* a prostaglandin, $C_{20}H_{32}O_5$, that specifically inhibits the formation of blood clots. [1975–80; PROSTA(TE) + CYCL(IC) + -IN[2], on the model of PROSTAGLANDIN]

pros·ta·glan·din (pros′tə glan′din), *n.* **1.** *Biochem.* any of a class of unsaturated fatty acids that are involved in the contraction of smooth muscle, the control of inflammation and body temperature, and many other physiological functions. **2.** *Pharm.* any commercial preparation of this substance. [1935–40; PROSTA(TE) + GLAND[1] + -IN[2]]

pro·stas (prō′stas), *n., pl.* **pro·sta·des** (prō stā′dēz). **1.** (in classical architecture) an antechamber or vestibule. **2.** (in a classical temple) the area included between parastades. [< Gk *prostás* lit., that which stands before (cf. PROSTASIS)]

pro·sta·sis (prō stā′sis), *n., pl.* **-ses** (-sēz). (in a classical temple) a pronaos or prostas before a cella. [< Gk *próstasis;* see PRO-[2], STASIS]

pros·tate (pros′tāt), *Anat.* —*adj.* **1.** Also, **pros·tat·ic** (pro stat′ik). of or pertaining to the prostate gland. —*n.* **2.** See **prostate gland.** [1640–50; < NL *prostata* < Gk *prostátēs* one standing before. See PRO-[2], -STAT]

pros·ta·tec·to·my (pros′tə tek′tə mē), *n., pl.* **-mies.** *Surg.* excision of part or all of the prostate gland. [1885–90; PROSTATE + -ECTOMY]

pros′tate gland′, *Anat.* an organ that surrounds the urethra of males at the base of the bladder, comprising a muscular portion, which controls the release of urine, and a glandular portion, which secretes an alkaline fluid that makes up part of the semen and enhances the motility and fertility of sperm. [1830–40]

prostat′ic u′tricle, *Anat.* a small pouch near the prostate gland that opens into the urethra. [1920–25]

pros·ta·tism (pros′tə tiz′əm), *n.* symptoms of prostate disorder, esp. obstructed urination, arising from benign enlargement or chronic disease of the prostate gland. [1895–1900; PROSTATE + -ISM]

pros·ta·ti·tis (pros′tə tī′tis), *n. Pathol.* inflammation of the prostate gland. [PROSTATE + -ITIS]

pro·ster·num (prō stûr′nəm), *n., pl.* **-na** (-nə), **-nums.** the ventral sclerite of the prothorax of an insect. [1820–30; < NL; see PRO-[1], STERNUM] —**pro·ster′nal,** *adj.*

pros·the·sis (pros thē′sis *for 1;* pros′thə sis *for 2*), *n., pl.* **-ses** (-sēz′ *for 1;* -sēz′ *for 2*). **1.** a device, either external or implanted, that substitutes for or supplements a missing or defective part of the body. **2.** *Gram., Prosody,* the addition of one or more sounds or syllables to a word or line of verse, esp. at the beginning. [1545–55; < LL < Gk *prósthesis* a putting to, addition, equiv. to *prós* to + *thésis* a placing; see THESIS] —**pros·thet·ic** (pros thet′ik), *adj.* —**pros·thet′i·cal·ly,** *adv.*

prosthet′ic den′tistry, prosthodontics.

prosthet′ic group′, *Biochem.* the nonprotein acid constituent of a conjugate protein, as the heme group of hemoglobin. [1895–1900]

pros·thet·ics (pros thet′iks), *n.* (*used with a singular or plural v.*) **1.** the branch of surgery or of dentistry that deals with the replacement of missing parts with artificial structures. Cf. **prosthodontics. 2.** the fabrication and fitting of prosthetic devices, esp. artificial limbs. [1890–95; see PROSTHETIC, -ICS]

pros·the·tist (pros′thi tist), *n.* a person skilled in making or fitting prosthetic devices. [1900–05; PROSTHET(ICS) + -IST]

pros·thi·on (pros′thē on′), *n. Craniom.* the most forward projecting point of the anterior surface of the upper jaw, in the midsagittal plane. [1920–25; < Gk *prósthion,* neut. of *prósthios* frontal, akin to *prósthen* forward] —**pros′thi·on′ic,** *adj.*

pros·tho·don·tics (pros′thə don′tiks), *n.* (*used with a singular v.*) the branch of dentistry that deals with the restoration and maintenance of oral function by the replacement of missing teeth and other oral structures by artificial devices. Also, **pros·tho·don·tia** (pros′thə don′shē, -shē ə). [1945–50; PROSTH(ESIS) + -ODONT + -ICS]

pros·tho·don·tist (pros′thə don′tist), *n.* a specialist in prosthodontics. [1915–20; PROSTHODONT(ICS) + -IST]

pros·tie (pros′tē), *n. Slang.* a prostitute. [PROST(ITUTE) + -IE]

Pro·stig·min (prō stig′min), *Pharm., Trademark.* a brand of neostigmine.

pros·ti·tute (pros′ti tōōt′, -tyōōt′), *n., v.,* **-tut·ed, -tut·ing.** —*n.* **1.** a woman who engages in sexual intercourse for money; whore; harlot. **2.** a man who engages in sexual acts for money. **3.** a person who willingly uses his or her talent or ability in a base and unworthy way, usually for money. —*v.t.* **4.** to sell or offer (oneself) as a prostitute. **5.** to put to any base or unworthy use: *to prostitute one's talents.* [1520–30; < L *prōstitūta,* n. use of fem. of *prōstitūtus,* ptp. of *prōstituere* to expose (for sale), equiv. to *prō-* PRO-[1] + *-stitū-,* comb. form of var. s. of *statuere* to cause to stand + *-tus* ptp. suffix; see STATUS] —**pros′ti·tu′tor,** *n.*

—**Syn. 1.** call girl, streetwalker, courtesan; trollop, strumpet.

pros·ti·tu·tion (pros′ti tōō′shən, -tyōō′-), *n.* **1.** the act or practice of engaging in sexual intercourse for money. **2.** base or unworthy use, as of talent or ability. [1545–55; < LL *prōstitūtiōn-* (s. of *prōstitūtiō*). See PROSTITUTE, -ION]

pro·sto·mi·ate (prō stō′mē āt′), *adj.* having a prostomium. [1885–90; PROSTOMI(UM) + -ATE[1]]

pro·sto·mi·um (prō stō′mē əm), *n., pl.* **-mi·a** (-mē ə). the unsegmented, preoral portion of the head of certain lower invertebrates. [1866–70; < NL < Gk *prostómion* mouth. See PRO-[2], STOMA, -IUM] —**pro·sto′mi·al,** *adj.*

pro·sto·on (prō stō′on), *n., pl.* **-sto·a** (-stō′ə). (in classical architecture) a portico. [< Gk *próstaon;* see PRO-[2], STOA]

pros·trate (pros′trāt), *v.,* **-trat·ed, -trat·ing,** *adj.* —*v.t.* **1.** to cast (oneself) face down on the ground in humility, submission, or adoration. **2.** to lay flat, as on the ground. **3.** to throw down level with the ground. **4.** to overthrow, overcome, or reduce to helplessness. **5.** to reduce to physical weakness or exhaustion. —*adj.* **6.** lying flat or at full length, as on the ground. **7.** lying face down on the ground, as in token of humility, submission, or adoration. **8.** overthrown, overcome, or helpless: *a country left prostrate by natural disasters.* **9.** physically weak or exhausted. **10.** submissive. **11.** utterly dejected or depressed; disconsolate. **12.** *Bot.* (of a plant or stem) lying flat on the ground. [1350–1400; (adj.) ME *prostrat* < L *prōstrātus,* ptp. of *prōsternere* to throw prone, equiv. to *prō-* PRO-[1] + *strā-,* var. s. of *sternere* to stretch out + *-tus* ptp. suffix; (v.) ME *prostraten,* deriv. of the adj.] —**pros·tra′tive** (pros′trə tiv), *adj.* —**pros′tra·tor,** *n.*

—**Syn. 6.** prone, supine, recumbent.

pros·tra·tion (pro strā′shən), *n.* **1.** the act of prostrating. **2.** the state of being prostrated. **3.** extreme mental or emotional depression or dejection: *nervous prostration.* **4.** extreme physical weakness or exhaustion: *heat prostration.* [1520–30; < LL *prōstrātiōn-* (s. of *prōstrātiō*) a lying prone. See PROSTRATE, -ION]

pro·style (prō′stīl), *Archit.* —*adj.* **1.** (of a classical temple) having a portico on the front with the columns in front of the antae. —*n.* **2.** a prostyle building or portico. [1690–1700; (adj.) < L *prostylos* < Gk *próstylos* with pillars in front, equiv. to *pro-* PRO-[2] + *-stylos* -STYLE[3]; (n.) < Gk *próstylon,* n. use of neut. of *próstylos*]

pros·y (prō′zē), *adj.,* **pros·i·er, pros·i·est. 1.** of the nature of or resembling prose. **2.** prosaic; dull, tedious, wearisome, or commonplace. [1805–15; PROSE + -Y[1]] —**pros′i·ly,** *adv.* —**pros′i·ness,** *n.*

pro·syl·lo·gism (prō sil′ə jiz′əm), *n. Logic.* a syllogism the conclusion of which is used as a premise of another syllogism; any of the syllogisms included in a polysyllogism except the last. Cf. **episyllogism.** [1575–85; < ML *prosyllogismus* < Gk *prosyllogismós.* See PRO-[2], SYLLOGISM]

prot-, var. of **proto-** before a vowel: *protamine.*

Prot., Protestant.

prot·ac·tin·i·um (prō′tak tin′ē əm), *n. Chem.* a radioactive, metallic element. *Symbol:* Pa; *at. no.:* 91. Also, **protoactinium.** [1915–20; PROT- + ACTINIUM]

pro·tag·o·nist (prō tag′ə nist), *n.* **1.** the leading character, hero, or heroine of a drama or other literary work. **2.** a proponent for or advocate of a political cause, social program, etc. **3.** the leader or principal person in a movement, cause, etc. **4.** the first actor in ancient Greek drama, who played not only the main role, but also other roles when the main character was offstage. Cf. **deuteragonist, tritagonist. 5.** *Physiol.* agonist. [1865–75; < Gk *prōtagōnistḗs* actor who plays the first part, lit., first combatant, equiv. to *prôt(os)* first + *agōnistḗs* one who contends for a prize, combatant, actor. See PROTO-, ANTAGONIST] —**pro·tag′o·nism,** *n.*

Pro·tag·o·ras (prō tag′ər əs), *n.* c480–c421 B.C., Greek Sophist philosopher. —**Pro·tag·o·re·an** (prō tag′ə rē′ən), *adj.* —**Pro·tag′o·re′an·ism,** *n.*

prot·a·mine (prō′tə mēn′, -min), *n. Biochem.* any of a group of arginine-rich, strongly basic proteins that are not coagulated by heat, occurring primarily in the sperm of fish. [1870–75; PROT- + AMINE]

prot·a·nom·a·ly (prō′tn om′ə lē), *n. Ophthalm.* a defect of vision characterized by a diminished response of the retina to red. [1935–40; PROT- + ANOMALY] —**prot′·a·nom′a·lous,** *adj.*

pro·ta·no·pi·a (prō′tn ō′pē ə), *n. Ophthalm.* a defect of vision in which the retina fails to respond to red or green. [1900–05; < NL; see PROT-, AN-[1], -OPIA] —**pro·ta·nop·ic** (prō′tn op′ik), *adj.*

prot·a·sis (prot′ə sis), *n., pl.* **-ses** (-sēz′). **1.** the clause expressing the condition in a conditional sentence, in English usually beginning with *if.* Cf. **apodosis. 2.** the first part of an ancient drama, in which the characters are introduced and the subject is proposed. Cf. **catastasis, catastrophe** (def. 4), **epitasis. 3.** (in Aristotelian logic) a proposition, esp. one used as a premise in a syllogism. [1610–20; < LL: introduction in a drama < Gk *prótasis* proposition, lit., a stretching forward, equiv. to *pro-* PRO-[2] + *tásis* a stretching (*ta-,* verbid s. of *teínein* to stretch + *-sis* -SIS)]

pro·te·an (prō′tē ən, prō tē′-), *adj.* **1.** readily assuming different forms or characters; extremely variable. **2.** changeable in shape or form, as an amoeba. **3.** (of an actor or actress) versatile; able to play many kinds of roles. **4.** (*cap.*) of, pertaining to, or suggestive of Proteus. [1590–1600; PROTE(US) + -AN] —**pro′te·an·ism,** *n.*

pro·te·ase (prō′tē āz′, -āz′), *n. Biochem.* any of a group of enzymes that catalyse the hydrolytic degradation of proteins or polypeptides to smaller amino acid polymers. [1900–05; PROTE(IN) + -ASE]

pro·tect (prə tekt′), *v.t.* **1.** to defend or guard from attack, invasion, loss, annoyance, insult, etc.; cover or shield from injury or danger. **2.** *Econ.* to guard (the industry or an industry of a nation) from foreign competition by imposing import duties. **3.** to provide funds for the payment of (a draft, note, etc.). —*v.i.* **4.** to provide, or be capable of providing, protection: *a floor wax that protects as well as shines.* [1520–30; < L *prōtēctus,* ptp. of *prōtegere* to cover in front, equiv. to *prō-* PRO-[1] + *teg-,* s. of *tegere* to cover (akin to TOGA, THATCH) + *-tus* ptp. suffix] —**pro·tect′i·ble, pro·tect′a·ble,** *adj.* —**pro·tect′i·bil′i·ty, pro·tect′a·bil′i·ty,** *n.*

—**Syn. 1.** screen, shelter. See **defend.** —**Ant. 1.** attack.

pro·tect·ant (prə tek′tənt), *n.* a substance, as a chemical spray, that provides protection, as against insects, frost, rust, etc.; protective agent. [1660–70, for an earlier sense; PROTECT + -ANT]

pro·tec·tee (prō′tek tē′, prə tek-), *n.* a person, as a head of state, for whom official protection is provided. [1595–1605; PROTECT + -EE]

pro·tect·ing (prə tek′ting), *adj.* providing protection or shelter. [1620–30; PROTECT + -ING[2]] —**pro·tect′ing·ly,** *adv.* —**pro·tect′ing·ness,** *n.*

pro·tec·tion (prə tek′shən), *n.* **1.** the act of protecting or the state of being protected; preservation from injury or harm. **2.** a thing, person, or group that protects: *This vaccine is a protection against disease.* **3.** patronage. **4.** *Insurance.* coverage (def. 1). **5.** *Informal.* **a.** money paid to racketeers for a guarantee against threatened violence. **b.** bribe money paid to the police, politicians, or other authorities for overlooking criminal activity. **6.** *Econ.* protectionism. **7.** a document that assures safety from harm, delay, or the like, for the person, persons, or property specified in it. **8.** *Archaic.* a document given by the U.S. customs authorities to a sailor traveling abroad certifying that the holder is a citizen of the U.S. [1275–1325; ME *proteccio(u)n* < LL *prōtēctiōn-* (s. of *prōtēctiō*) a covering in front. See PROTECT, -ION] —**pro·tec′tion·al,** *adj.*

—**Syn. 1.** security, refuge, safety. **2.** guard, defense, shield, bulwark. See **cover. 3.** aegis, sponsorship. **7.** pass, permit.

pro·tec·tion·ism (prə tek′shə niz′əm), *n.* **1.** *Econ.* the theory, practice, or system of fostering or developing domestic industries by protecting them from foreign competition through duties or quotas imposed on importations. **2.** any program, policy, or system of laws that seeks to provide protection for property owners, wildlife,

pro-Nor′dic, *adj.*
pro-North′, *adj.*
pro-North′ern, *adj.*
pro′-Nor·we′gian, *adj., n.*
pro-op′er·a, *adj.*
pro′-O·ri·en′tal, *adj., n.*
pro-or′tho·dox′, *adj.*
pro-or′tho·dox′y, *adj.*
pro·pac′i·fism, *n.*
pro·pac′i·fist, *n., adj.*
pro-Pan′a·ma′, *adj.*
pro′-Pan·a·ma′ni·an, *adj., n.*
pro·pa′pist, *n., adj.*
pro-Par′a·guay′, *adj.*
pro′-Par·a·guay′an, *adj., n.*
pro′pa·tri·ot′ic, *adj.*
pro·pa′tri·ot·ism, *n.*
pro·pa′tron·age, *adj.*
pro·pay′ment, *adj.*
pro′-Pe·ru′vi·an, *adj., n.*
pro-Phil′ip·pine′, *adj.*
pro-Pol′ish, *adj.*
pro·pol′i·tics, *adj.*
pro′-Por·tu·guese′, *adj., n., pl.* **-guese.**

—**Syn.** 1. lip, verge. RIM, BRIM refer to the boundary of a circular or curved area. A RIM is a line or surface bounding such an area; an edge or border: *the rim of a glass.* BRIM usually means the inside of the rim, at the top of a hollow object (except of a hat), and is used particularly when the object contains something: *The cup was filled to the brim.* —**Ant.** 1. center.

Ri·ma (rē′mə), *n.* a female given name.

Rim·baud (ram bō′; *Fr.* ran bō′), *n.* **(Jean Ni·co·las) Ar·thur** (zhän nē kō lä′ ar tür′), 1854–91, French poet.

rime[1] (rīm), *n., v.,* **rimed, rim·ing.** —*n.* **1.** Also called **rime′ ice′.** an opaque coating of tiny, white, granular ice particles, caused by the rapid freezing of supercooled water droplets on impact with an object. Cf. **frost** (def. 2), **glaze** (def. 17). —*v.t.* **2.** to cover with rime or hoarfrost. [bef. 900; ME *rim,* OE *hrīm;* c. D *rijm,* ON *hrīm*] —**rime′less,** *adj.*

rime[2] (rīm), *n., v.t., v.i.,* **rimed, rim·ing.** rhyme.

rime riche (rēm′, rēsh′), *pl.* **rimes riches** (rēm′ rēsh′). *Pros.* rhyme created by the use of two different words, or groups of words, of which both the stressed syllables and any following syllables are identical, as in *lighted, delighted.* Also called **identical rhyme, perfect rhyme, rich rhyme.** [1900–05; < F: lit., rich rhyme]

rime·ster (rīm′stər), *n.* rhymester.

rime suf·fi·sante (rēm sy fē zänt′), *pl.* **rimes suf·fi·santes** (rēm sy fē zänt′). *French.* See **full rhyme.**

rim·fire (rim′fī′ər), *adj.* **1.** (of a cartridge) having the primer in a rim encircling the base. Cf. **center-fire** (def. 1). **2.** (of a firearm) designed for the use of such cartridges. [1865–70, *Amer.*; RIM + FIRE]

Rim·i·ni (rim′ə nē; *It.* rē′mē nē), *n.* **1. Francesca da.** See **Francesca da Rimini. 2.** Ancient, **Ariminum.** a seaport in NE Italy, on the Adriatic. 126,025.

rim′ light′ing, backlighting. [1935–40]

rim′ lock′, a lock nailed or screwed to one face of a door, gate, etc., as opposed to one built into its edge. [1835–45]

rim′ man′, copyreader (def. 2). [1930–35]

rimmed (rimd), *adj.* **1.** having a rim: *Do you wear rimmed or rimless glasses?* **2.** having a rim of a specified kind (often used in combination): *Your red-rimmed eyes show that you have been crying.* [1720–30; RIM + -ED[3]]

rimmed′ steel′, a low-carbon steel containing enough iron oxide so that there is continuous generation of carbon monoxide during solidification. [1925–30]

Rim·mer (rim′ər), *n.* **William,** 1816–79, U.S. sculptor and painter, born in England.

ri·mose (rī′mōs, rī mōs′), *adj.* full of crevices, chinks, or cracks. Also, **ri·mous** (rī′məs). [1720–30; < L *rīmōsus* full of cracks, equiv. to *rīm(a)* cleft, crack, chink + *-ōsus* -OSE[1]] —**ri′mose·ly,** *adv.* —**ri·mos·i·ty** (rī mos′i tē), *n.*

Ri·mous·ki (ri mōō′skē), *n.* a city in SE Quebec, in SE Canada, on the St. Lawrence River. 27,897.

rim·ple (rim′pəl), *n., v.,* **-pled, -pling.** —*n.* **1.** a wrinkle. —*v.t., v.i.* **2.** to wrinkle; crumple; crease. [1400–50; late ME; cf. MD, MLG *rimpel;* akin to RUMPLE]

rim·rock (rim′rok′), *n. Geol.* **1.** rock forming the natural boundary of a plateau or other rise. **2.** bedrock forming the natural boundary of a placer or of a gravel deposit. [1855–60, *Amer.*; RIM + ROCK[1]]

Rim·sky-Kor·sa·kov (rim′skē kôr′sə kôf′, -kof′; *Russ.* ryēm′skyĭ kôr′sə kəf), *n.* **Ni·co·lai An·dre·e·vich** (nyi kə lī′ un dryē′yi vyich), 1844–1908, Russian composer. Also, **Rim′ski-Kor′sa·kov′, Rim′sky-Kor′sa·koff′.**

rim·stone (rim′stōn′), *n. Geol.* a calcareous deposit forming a dam at the edge or outlet of an overflowing pool of water, as in a cavern. [1925–30; RIM + STONE]

rim·y (rī′mē), *adj.,* **rim·i·er, rim·i·est.** covered with rime. [bef. 1000; OE *hrīmig* (not recorded in ME). See RIME[1], -Y[1]]

rin (rin), *n., pl.* **rin.** a money of account of Japan, the thousandth part of a yen or the tenth part of a sen. [1870–75; < Japn *rin* < MChin, equiv. to Chin *lí*; cf. LIKIN]

Ri·na (rē′nə), *n.* a female given name.

rin·ceau (*Fr.* ran sō′), *n., pl.* **-ceaux** (*Fr.* -sō′). an ornamental foliate or floral motif. [1770–80; < F; MF *rainsel* < VL **rāmusellus,* deriv. of LL *rāmusculus,* dim. of *rāmus* branch (see RAMUS)]

rind[1] (rīnd), *n.* **1.** a thick and firm outer coat or covering, as of certain fruits, cheeses, and meats: *watermelon rind; orange rind; bacon rind.* **2.** the bark of a tree. [bef. 900; ME, OE *rind(e)* tree bark, crust; c. G *Rinde*] —**rind′less,** *adj.* —**rind′y,** *adj.*

rind[2] (rīnd, rind), *n.* a piece of iron running across an upper millstone as a support. Also, **rynd.** Also called **millrind.** [1300–50; ME *rynd*; c. MD *rijn,* MLG *rīn*]

rin·der·pest (rin′dər pest′), *n. Vet. Pathol.* an acute, usually fatal infectious disease of cattle, sheep, etc., caused by a paramyxovirus of the genus *Morbillivirus* and characterized by high fever, diarrhea, and lesions of the skin and mucous membranes. Also called **cattle plague.** [1860–65; < G, equiv. to *Rinder* cattle (pl. of *Rind*) + *Pest* pestilence]

Rine·hart (rīn′härt), *n.* **Mary Roberts,** 1876–1958, U.S. novelist and playwright.

rin·for·zan·do (*It.* rēn′fôr tsän′dô), *adj., adv.* sforzando. [1705–1805; < It reinforcing (ger. of *rinforzare,* equiv. to *ri-* RE- + *inforzare* to ENFORCE)]

CONCISE ETYMOLOGY KEY: <, descended or borrowed from; >, whence; b., blend of, blended; c., cognate with; cf., compare; deriv., derivative; equiv., equivalent; imit., imitative; obl., oblique; r., replacing; s., stem; sp., spelling, spelled; resp., respelling, respelled; trans., translation; ?, origin unknown; *, unattested; ‡, probably earlier than. See the full key inside the front cover.

ring[1] (ring), *n., v.,* **ringed, ring·ing.** —*n.* **1.** a typically circular band of metal or other durable material, esp. one of gold or other precious metal, often set with gems, for wearing on the finger as an ornament, a token of betrothal or marriage, etc. **2.** anything having the form of such a band: *a napkin ring; a smoke ring.* **3.** a circular or surrounding line or mark: *dark rings around the eyes.* **4.** a circular course: *to dance in a ring.* **5.** a number of persons or things situated in a circle or in an approximately circular arrangement: *a ring of stones; a ring of dope smugglers.* **6.** the outside edge of a circular body, as a wheel; *hills.* **6.** the outside edge of a circular body, as a wheel; rim. **7.** an enclosed area, often circular, as for a sports contest or exhibition: *a circus ring.* **8.** a bullring. **9.** an enclosure in which boxing and wrestling matches take place, usually consisting of a square, canvas-covered platform with surrounding ropes that are supported at each corner by posts. **10.** the sport of boxing; prizefighting: *the heyday of the ring.* **11.** (formerly in the U.S., now only in Brit.) an area in a racetrack where bookmakers take bets. **12.** a group of persons cooperating for unethical, illicit, or illegal purposes, as to control stock-market prices, manipulate politicians, or elude the law: *a ring of dope smugglers.* **13.** a single turn in a spiral or helix or in a spiral course. **14.** *Geom.* the area or space between two concentric circles. **15.** See **annular ring. 16.** a circle of bark cut from around a tree. **17.** *Chem.* a number of atoms so united that they may be graphically represented in cyclic form. Cf. **chain** (def. 7). **18.** *Archit.* rowlock (def. 1). **19.** a bowlike or circular piece at the top of an anchor, to which the chain or cable is secured. See diag. under **anchor. 20.** Also called **spinning ring.** *Textiles.* (in the ring-spinning frame) a circular track of highly polished steel on which the traveler moves and which imparts twists to the yarn by variations in its vertical movement. **21.** *Auto., Mach.* See **piston ring. 22.** *Math.* a set that is closed under the operations of addition and multiplication and that is an Abelian group with respect to addition and an associative semigroup with respect to multiplication and in which the distributive laws relating the two operations hold. **23. run rings around,** to be obviously superior to; surpass; outdo: *As an artist, she can run rings around her brother.* **24. throw** or **toss one's hat in** or **into the ring.** See **hat** (def. 7).

—*v.t.* **25.** to surround with a ring; encircle. **26.** to form into a ring. **27.** to insert a ring through the nose of (an animal). **28.** to bem in (animals) by riding or circling about them. **29.** to girdle (def. 11). **30.** (in horseshoes, ringtoss, etc.) to encircle (a stake or peg) with a ring, horseshoe, etc.

—*v.i.* **31.** to form a ring or rings. **32.** to move in a ring or a constantly curving course: *The road rings around the mountain.* [bef. 900; ME; OE *hring*; c. D, G *ring,* ON *hringr*; akin to RANK[1]] —**ring′like′,** *adj.* —**ring′less,** *adj.*

—**Syn. 2.** circle, circlet, hoop; annulus. **7.** arena, rink, circle. **12.** bloc, coterie, confederacy, league; gang, mob, syndicate. RING, CLIQUE are terms applied with disapproving connotations to groups of persons. RING suggests a small and intimately related group, combined for selfish and often dishonest purposes: *a gambling ring.* A CLIQUE is a small group that prides itself on its congeniality and exclusiveness: *cliques in a school.*

ring[2] (ring), *v.,* **rang, rung, ring·ing,** *n.* —*v.i.* **1.** to give forth a clear resonant sound, as a bell when struck: *The doorbell rang twice.* **2.** to make a given impression on the mind; appear: *words that rang false; a story that rings true.* **3.** to cause a bell or bells to sound, esp. as a summons: *Just ring if you need anything.* **4.** to sound loudly; be loud or resonant; resound (often fol. by *out*): *His brave words rang out.* **5.** to be filled with sound; reecho with sound, as a place. **6.** (of the ears) to have the sensation of a continued humming sound. **7.** *Chiefly Brit.* to telephone. —*v.t.* **8.** to cause (a bell or device with a bell) to ring; sound by striking: *to ring a bell.* **9.** to produce (sound) by or as if by ringing: *The bell rang a low tone.* **10.** to announce or proclaim, usher in or out, summon, signal, etc., by or as if by the sound of a bell: *to ring someone's praises; The bell rang the hour.* **11.** to test (a coin or other metal object) by the sound it produces when struck against something. **12.** *Chiefly Brit.* to telephone. **13. ring a bell.** See **bell**[1] (def. 10). **14. ring down the curtain, a.** to direct that the curtain of a theater be lowered or closed. **b.** to lower or close the curtain in front of a stage. **15. ring down the curtain on,** to bring to an end: *The accident rang down the curtain on his law career.* **16. ring in, a.** to indicate one's arrival at work by punching in on a time clock. **b.** *Informal.* to introduce artfully or fraudulently: *to ring in an imposter.* **17. ring off, a.** to terminate a telephone conversation. **b.** *Brit. Slang.* to stop talking. **c.** *Brit. Slang.* to go away. **18. ring out, a.** to indicate one's departure from work by punching out on a time clock. **b.** to make a sound or noise; resound: *The church bells rang out.* **19. ring the bell.** See **bell**[1] (def. 11). **20. ring the changes.** See **change** (def. 38). **21. ring up, a.** to register (the amount of a sale) on a cash register. **b.** to accomplish or record: *to ring up a series of successes.* **c.** *Chiefly Brit.* to telephone. **22. ring up the curtain, a.** to direct that the curtain of a theater be raised or opened. **b.** to raise or open the curtain in front of a stage. **23. ring up the curtain on,** to begin; inaugurate; initiate: *The $100-a-plate dinner rang up the curtain on the hospital's fund-raising drive.* —*n.* **24.** a ringing sound, as of a bell or bells: *the ring of sleigh bells.* **25.** a sound or tone likened to the ringing of a bell: *Rings of laughter issued from the school.* **26.** any loud sound; sound continued, repeated, or reverberated: *the ring of iron upon stone.* **27.** a set or peal of bells. **28.** a telephone call: *Give me a ring tomorrow.* **29.** an act or instance of ringing a bell: *No one answered my ring.* **30.** a characteristic sound, as of a coin. **31.** the aspect or impression presented by a statement, an action, etc., taken as revealing a specified inherent quality: *a ring of assurance in her voice; the ring of truth; a false ring.* [bef. 900; ME *ringen,* OE *hringan*; c. ON *hringja,* G *ringen*] —**ring′ing·ly,** *adv.* —**ring′ing·ness,** *n.*

—**Syn. 31.** sound, tone, quality.

Ring (ring), *n.* a male given name.

ring-a-lie·vi·o (ring′ə lē′vē ō′), *n.* a game played usually between two teams in which the members of a team attempt to find, capture, and imprison the members of the other, who can be freed only by a teammate not yet captured. [1900–05; var. of *ring relievo,* p. RELIEVE + -O]

ring-a-round-the-ros·ey (ring′ə round′thə rō′zē), a children's game in which the players sing while going around in a circle and squat when the lyrics "all fall down" are sung. Also, **ring′-a-round′-the-ro·sy, ring′-a-round′-a-ros′ey.** [1880–85; prob. ROSE[1] + -Y[3]]

ring·bark (ring′bärk′), *v.t.* girdle (def. 11). [1885–90; RING[1] + BARK[2]]

ring′-billed gull′ (ring′bild′), a North American gull, *Larus delawarensis,* having a black ring around the bill. [1825–35, *Amer.*]

ring′ bind′er, a loose-leaf binder in which the sheets are held in by two or more rings that can be made to snap open. [1925–30]

ring·bolt (ring′bōlt′), *n.* a bolt with a ring fitted in the eye at its head. [1620–30; RING[1] + BOLT[1]]

ring·bone (ring′bōn′), *n. Vet. Pathol.* a morbid bony growth on the pastern bones of a horse, often resulting in lameness. [1515–25; RING[1] + BONE]

ring′ com′pound, *Chem.* a compound whose structural formula contains a closed chain or ring of atoms; cyclic compound. Cf. **cyclic** (def. 3). [1930–35]

***Ring′* Cy′cle.** See **Ring of the Nibelung, The.**

ring′ dance′. See **round dance.** [1590–1600]

ring·dove (ring′duv′), *n.* **1.** a small Old World dove, *Streptopelia risoria,* having a black half ring around the nape of the neck. **2.** See **wood pigeon.** Also, **ring′-dove′.** [1530–40; RING[1] + DOVE[2]]

ringed (ringd), *adj.* **1.** having or wearing a ring or rings. **2.** marked or decorated with or as if with a ring or rings. **3.** surrounded by or as if by a ring or rings; formed of or with rings; ringlike or annular: *a ringed growth.* **5.** *Armor.* noting armor having rings sewn side by side to a flexible backing. [bef. 900; ME; OE *hringed*; see RING[1], -ED[2], -ED[3]]

ringed′ plov′er, any of several cosmopolitan plovers of the genus *Charadrius,* esp. *C. hiaticula,* brown above and white below with a black band around the breast. [1775–85]

ringed′ snake′. See **ring snake.**

rin·gent (rin′jənt), *adj.* **1.** gaping. **2.** *Bot.* having widely spread lips, as some corollas. [1750–60; < L *rīgent-* (s. of *rīgēns,* prp. of *rīngī* to gape), equiv. to *rīng-* open the mouth + *-ent-* -ENT; cf. RICTUS]

ring·er[1] (ring′ər), *n.* **1.** a person or thing that encircles, rings, etc. **2.** a quoit or horseshoe so thrown as to encircle the peg. **3.** the throw itself. **4.** Also, **ring taw.** *Marbles.* a game in which players place marbles in a cross marked in the center of a circle, the object being to knock as many marbles as possible outside the circle by using another marble shooter. *Australian.* a highly skilled sheep shearer. [1815–; RING[1] + -ER[1]]

ring·er[2] (ring′ər), *n.* **1.** a person or thing that rings; makes a ringing noise: *a ringer of bells; a bell that is a loud ringer.* **2.** See **dead ringer. 3.** *Slang.* **a.** a horse, athlete, or the like entered in a competition under false representation as to identity or ability. **b.** a substitute paid by another to take an exam. **c.** any person or thing that is fraudulent; fake or impostor. **d.** a substitute, in addition, as a professional musician hired to strengthen a school orchestra: *We hired three ringers for the commencement concert.* [1375–1425; late ME; see RING[1], -ER[1]]

Ring′er's solu′tion (ring′ərz), *Pharm.* an aqueous solution of the chlorides of sodium, potassium, and calcium in the same concentrations as normal body fluid, used chiefly in the laboratory for sustaining tissues. Also, **isotonic sodium chloride solution.** [1890–95; named after Sydney *Ringer* (1835–1910), English physician]

ring′ fin′ger, the finger next to the little finger of the left hand, on which an engagement ring or wedding band is traditionally worn. [bef. 1000; ME, OE]

ring′ frame′. See **ring-spinning frame.**

ring′ gage′, a gage for checking the diameters of circular manufactured objects, consisting of a ring having a hole that is of either the maximum or minimum allowable diameter.

ring′ gal′axy, *Astron.* a galaxy having the shape of an elliptical ring: thought to be the result of a collision between two galaxies.

ring′ gate′, *Metall.* a gate having a widened opening containing a centered disk to prevent molten metal from falling in a direct vertical stream.

ring′ gear′, *Mach.* See **internal gear.**

ring·git (ring′git), *n.* **1.** Also called **dollar,** a money, cupronickel coin, and monetary unit of Malaysia, equal to 100 sen. **2.** dollar (def. 4). [1965–70; < Malay *ringgit* lit., serrated, milled]

ring·hals (ring′hals), *n.* a highly venomous snake, *Hemachatus haemachatus,* of southern Africa, related to the cobras, having one to three light-colored bands across its throat and characterized by its ability to accurately spit its venom up to 7 ft. (2.1 m) away. Also, **hals.** [< Afrik, equiv. to *ring* RING[1] + *hals* neck]

ring·lead·er (ring′lē′dər), *n.* a person who leads others, esp. in opposition to authority, law, etc.: *a ringleader of revolutionary activities.* [1495–1505; RING[1] + LEADER]

ring·let (ring′lit), *n.* **1.** a curled look of hair. **2.** a small ring or circle. **3.** *Astron.* one of the thin or narrow rings that compose the major rings of Saturn. [1605–15; RING[1] + -LET] —**ring′let·ed,** *adj.*

ring·light (ring′līt′), *n.* a circular electronic flash that surrounds a camera lens, used esp. for even illumination in closeup photography. [RING[1] + LIGHT[1]]

EXHIBIT 2

United States Patent [19]

Holmberg et al.

[11] **Patent Number: 4,820,222**

[45] **Date of Patent: Apr. 11, 1989**

[54] **METHOD OF MANUFACTURING FLAT PANEL BACKPLANES INCLUDING IMPROVED TESTING AND YIELDS THEREOF AND DISPLAYS MADE THEREBY**

[75] Inventors: **Scott H. Holmberg; Richard A. Flasck,** both of San Ramon, Calif.

[73] Assignee: **Alphasil, Inc.,** Fremont, Calif.

[21] Appl. No.: **948,224**

[22] Filed: **Dec. 31, 1986**

[51] **Int. Cl.**[4] **G09G 3/22**

[52] **U.S. Cl.** **445/3;** 340/784; 445/24; 437/8

[58] **Field of Search** 313/500; 340/784; 437/8; 445/3, 24, 25; 29/593

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Primary Examiner—Kenneth J. Ramsey

Attorney, Agent, or Firm—Silverman, Cass, Singer & Winburn, Ltd.

[57] **ABSTRACT**

Subdivided pixels are provided with interconnected and hence redundant row and column bus lines to reduce fatal defects. The respective redundant row and column lines also can be interconnected between subpixels to further reduce defects. One defective subpixel is generally an acceptable non-fatal defect, since the rest of the subpixels are still operative. The subpixels also can be formed with common row and column bus lines. The pixels or subpixels can be connected in a serial serpentine pattern to test all row or all column bus lines at once. After testing, the serial connections are broken.

31 Claims, 5 Drawing Sheets

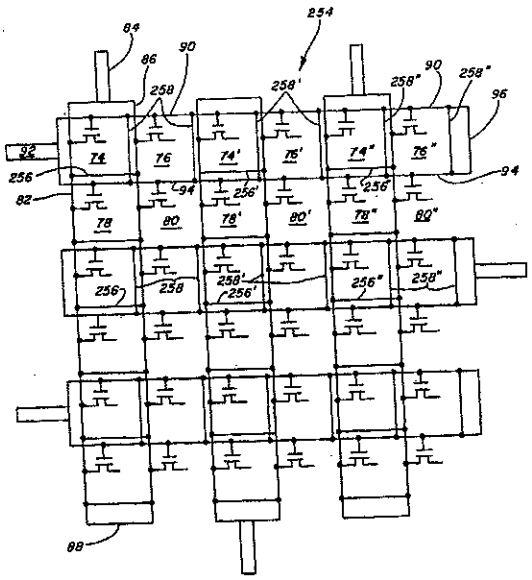


FIG. 1

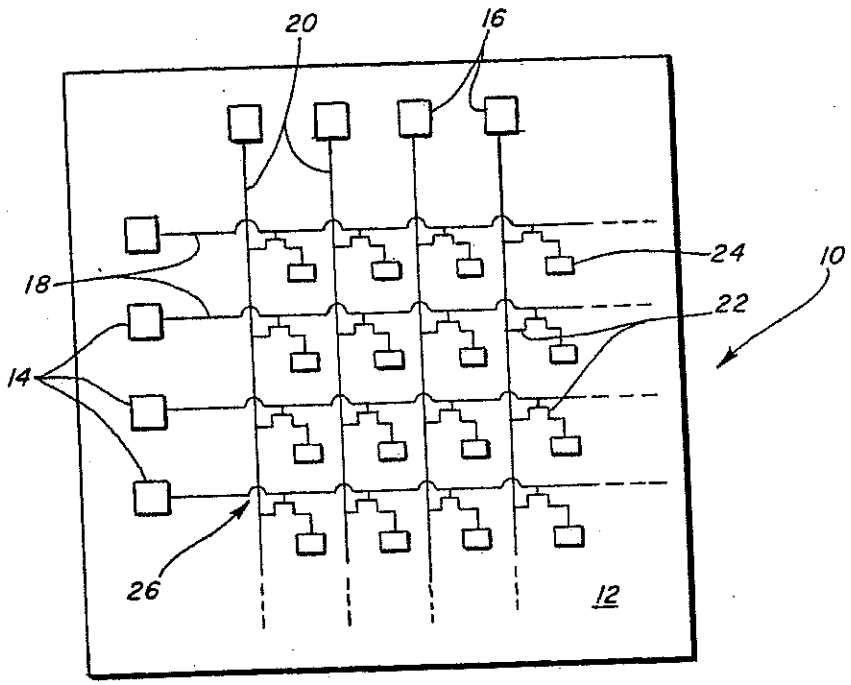
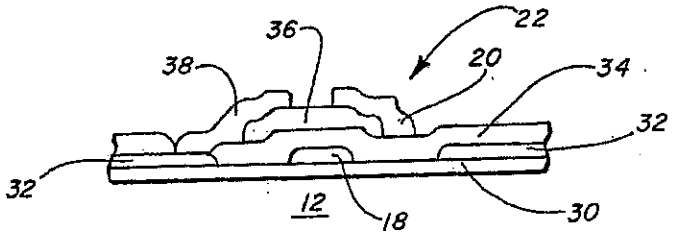


FIG. 2



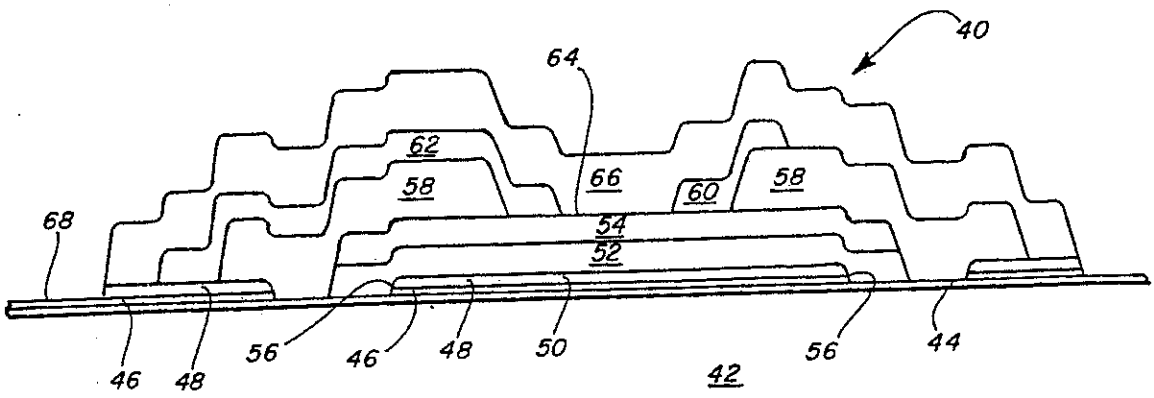


FIG. 3

FIG. 4

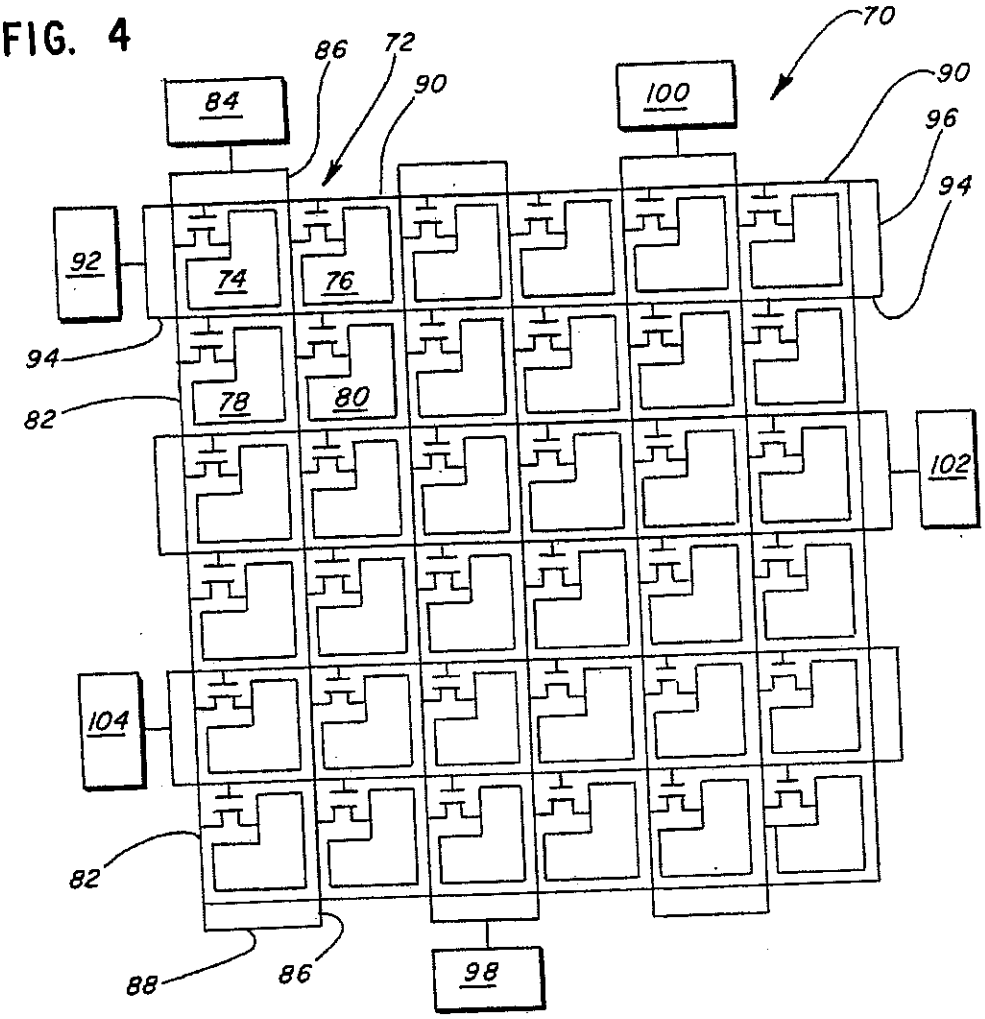

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FIG. 5

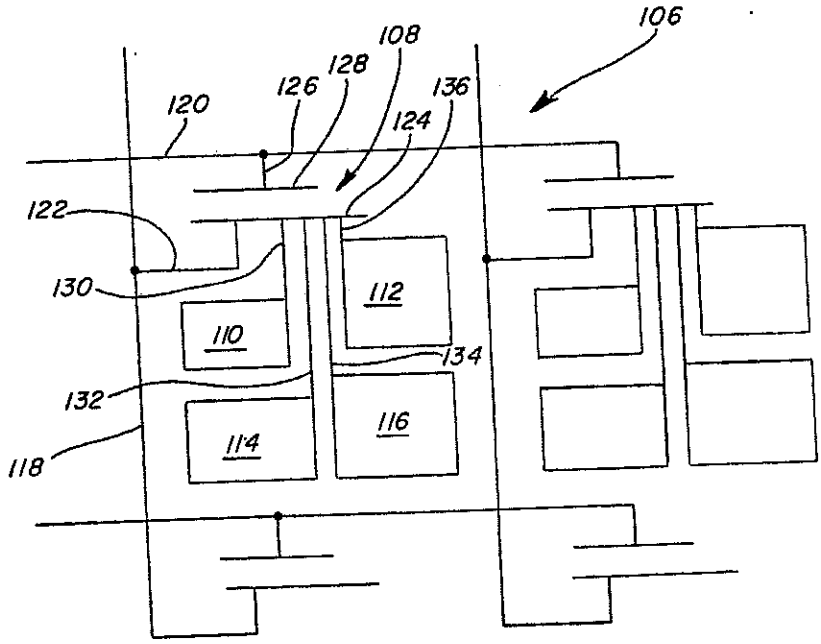
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FIG. 6

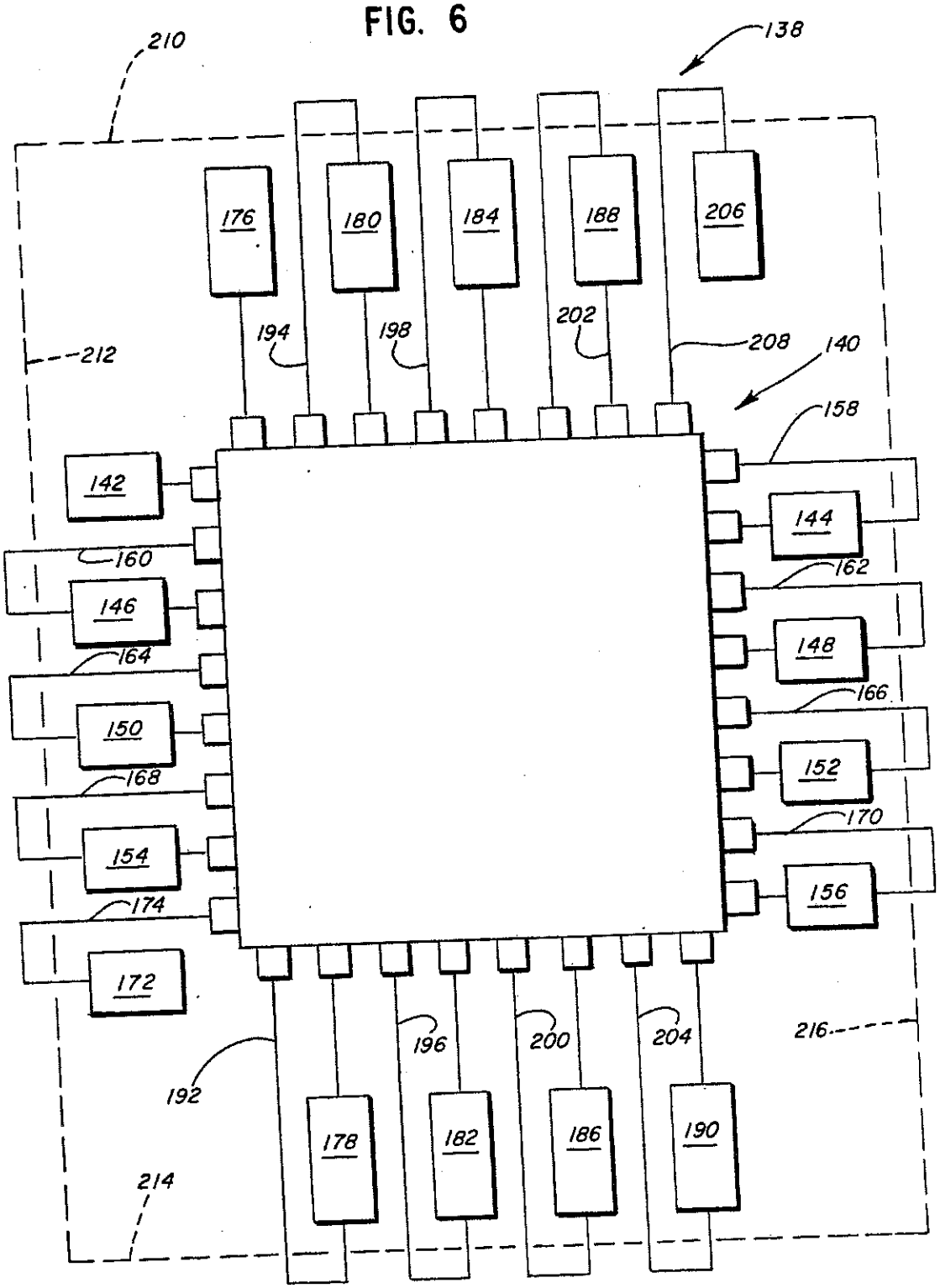
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FIG. 7

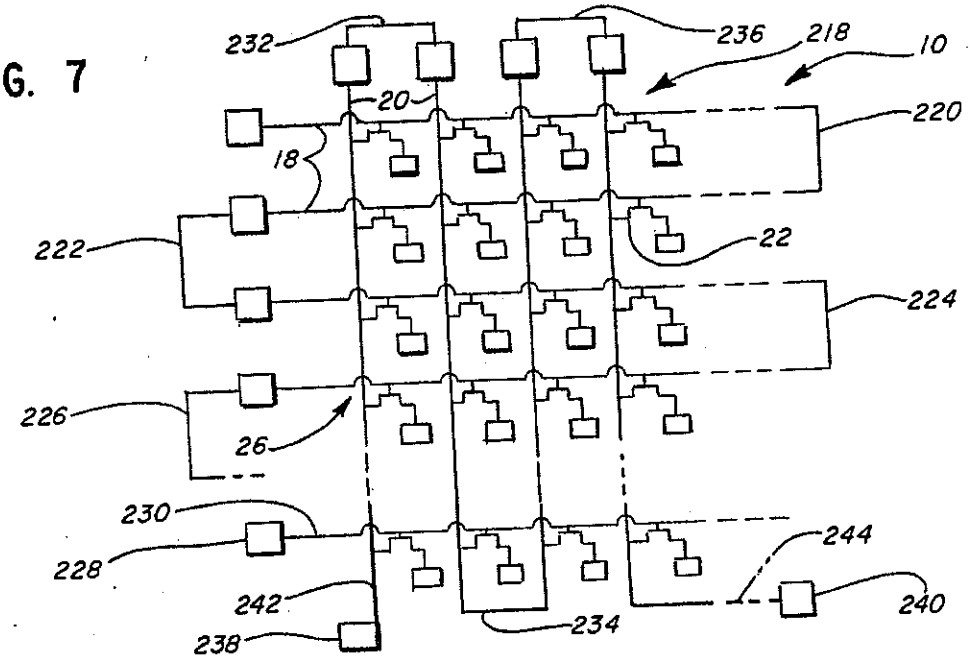
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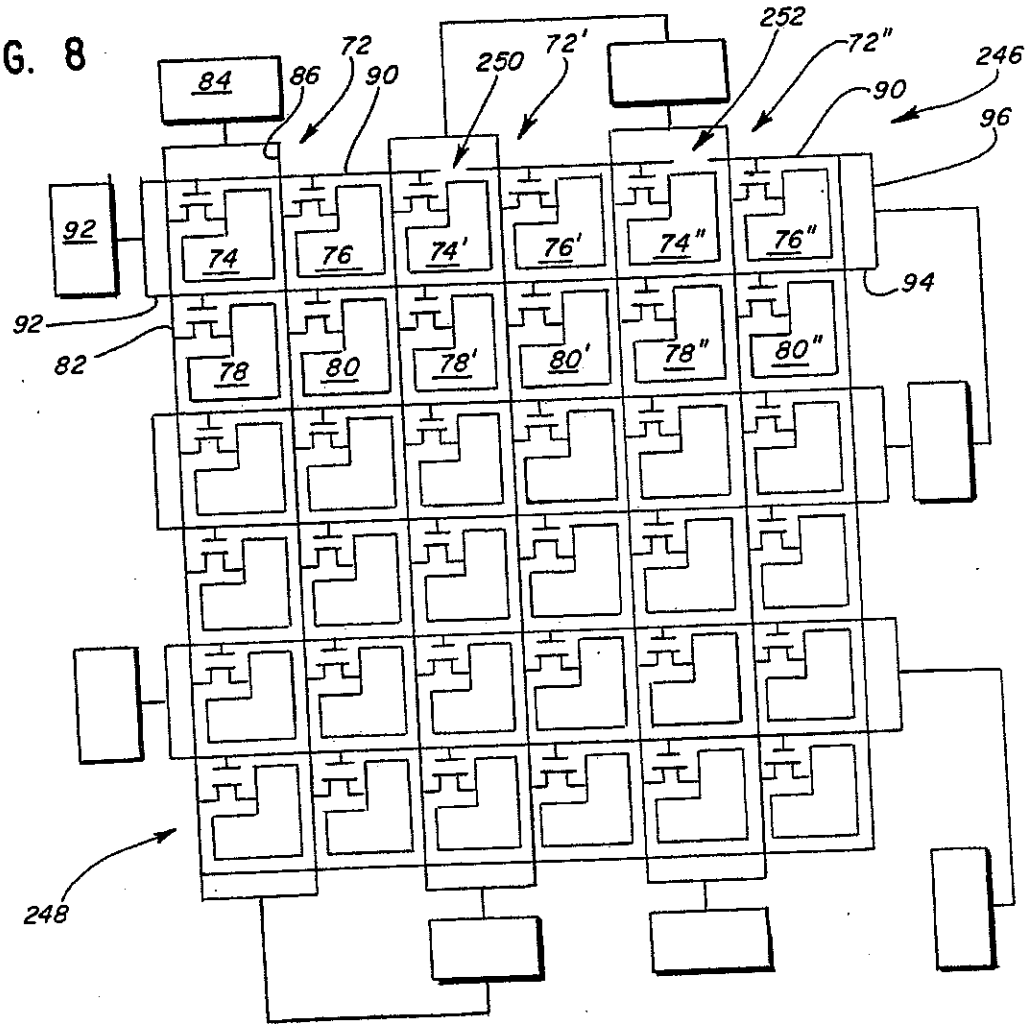
FIG. 8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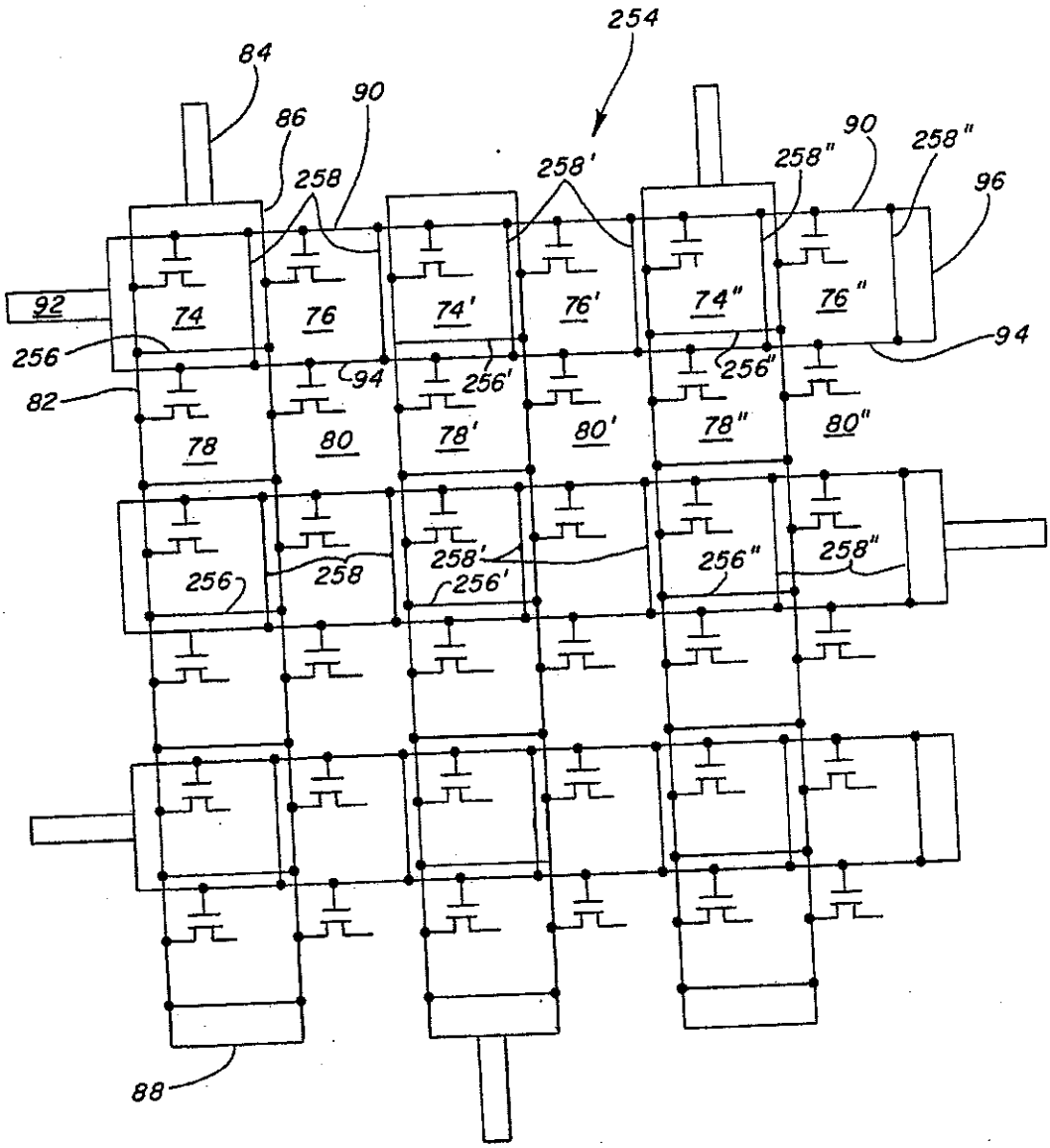
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FIG. 9

METHOD OF MANUFACTURING FLAT PANEL BACKPLANES INCLUDING IMPROVED TESTING AND YIELDS THEREOF AND DISPLAYS MADE THEREBY

BACKGROUND OF THE INVENTION

The present invention pertains to improved flat panel displays and methods of making and testing the displays. More particularly, the present invention is directed to methods of increasing the manufacturing yields of flat panel display backplanes and the displays made therefrom.

In recent years there has been growing interest in flat panel displays, such as those which employ liquid crystals, electrochromic or electroluminescence, as replacements for conventional cathode ray tubes (CRT). The flat panel displays promise lighter weight, less hulk and substantially lower power consumption than CRT's. Also, as a consequence of their mode of operation, CRT's nearly always suffer from some distortion. The CRT functions by projecting an electron beam onto a phosphor-coated screen. The beam will cause the spot on which it is focused to glow with an intensity proportional to the intensity of the beam. The display is created by the constantly moving beam causing different spots on the screen to glow with different intensities. Because the electron beam travels a further distance from its stationary source to the edge of the screen than it does to the middle, the beam strikes various points on the screen at different angles with resulting variation in spot size and shape (i.e. distortion).

Flat panel displays are manufactured to be substantially free of such distortion. In the manufacture of flat panel displays the circuit elements are deposited and patterned, generally by photolithography, on a substrate, such as glass. The elements are deposited and etched in stages to build a device having a matrix of perpendicular rows and columns of circuit control lines with a pixel contact and control element between the control line rows and columns. The pixel contact has a medium thereon which is a substance that either glows (active) or changes its response to ambient light (passive) when a threshold voltage is applied across the medium control element. The medium can be a liquid crystal, electroluminescent or electrochromic materials such as zinc sulfide, a gas plasma of, for example, neon and argon, a dichloroic dye, or such other appropriate material or device as will luminesce or otherwise change optical properties in response to the application of voltage thereto. Light is generated or other optical changes occur in the medium in response to the proper voltage applied thereto. Each optically active medium is generally referred to as a picture element or "pixel".

The circuitry for a flat panel display is generally designed such that the flat panel timeshares, or multiplexes, digital circuits to feed signals to one row and column control line of the pixels at a time. Generally one driving circuit is used for each row or column control line. In this way a subthreshold voltage can be fed to an entire row containing hundreds of thousands of pixels, keeping them all dark or inactive. Then a small additional voltage can be supplied selectively to particular columns to cause selected pixels to light up or change optical properties. The pixels can be made to glow brighter by applying a larger voltage or current of a longer pulse of voltage or current. Utilizing liquid crystal displays (LCD's) with twisted nematic active material, the display is substantially transparent when not activated and becomes light absorbing when activated. Thus, the image is created on the display by sequentially activating the pixels, row by row, across the display. The geometric distortion described above with respect to CRT's is not a factor in flat panel displays since each pixel sees essentially the same voltage or current.

One of the major problems that arises with respect to the prior art method of manufacture of backplanes for active matrix displays (e.g. those employing thin film transistors at each pixel) is that they generally suffer production yield problems similar to those of integrated circuits. That is, the yields of backplanes produced are generally not 100% and the yield (percentage of backplanes with no defects) can be 0% in a worst case. High quality displays will not tolerate any defective pixel transistors or other components. Also, larger size displays are generally more desirable than smaller size displays. Thus, a manufacturer is faced with the dilemma of preferring to manufacture larger displays, but having to discard the entire product if even one pixel is defective. In other words, the manufacturer suffers a radically increased manufacturing cost per unit resulting from decreasing usable product yield.

These problems of increased cost and decreased yield are dramatically improved in the present invention by providing methods of manufacturing display backplanes and the resulting displays with a greatly reduced number of fatal defects.

SUMMARY OF THE INVENTION

There is provided improved methods of manufacturing backplanes and the resulting flat panel displays to greatly increase the manufacturing yield, decrease manufacturing costs and decrease the number of fatal display defects.

These improvements are accomplished by subdividing each of the backplanes and hence display pixels into two or more subpixels. Each subpixel is formed with its own row (gate) line and column (source) bus line. Each subpixel pair of bus row lines and each pair of bus column lines are connected at the opposite sides of the display to provide redundant bus row lines and bus column lines. A break in the row or column bus line therefore will not affect the operation of the display, because the pixel will receive current from the other interconnected end of the row or column bus line Further, by providing subpixels, a defective active device at a subpixel will result in less than the whole pixel being defective and hence can be an acceptable nonfatal defect increasing the display yields. Subpixels also can be formed with a common row and a common column bus line.

The cost of manufacturing the display backplanes and hence the displays also can be reduced by serial loop testing of the row and column bus lines during manufacture. Each of the row and column bus lines is serially interconnected in a serpentine fashion at the opposite edges of the display. This allows all the row and all the column bus lines to be tested merely by contacting the two free ends of each of the serially interconnected row and column bus lines. Further, by applying the proper voltage to the ends of both the row and column bus lines, all the pixels or subpixels will be activated to provide one whole display test of all the pixels or subpixels at once. After final testing, the row and bus col-

umn line interconnections are broken to complete the display.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view schematic representation of an active matrix display hackplane made by a prior art method;

FIG. 2 is a cross-section of one transistor of the prior art backplane which could be utilized with the present invention;

FIG. 3 is a cross-section of one transistor which could be utilized with the present invention;

FIG. 4 is a plan view schematic representation of one embodiment of a subpixel matrix display of the present invention;

FIG. 5 is a plan view schematic representation of another embodiment of a subpixel matrix display of the present invention;

FIG. 6 is a plan view schematic representation of one embodiment of serial serpentine testing of the subpixel row and column bus lines in accordance with the present invention;

FIG. 7 is a plan schematic view of serial serpentine testing of conventional row and column bus lines in accordance with the present invention;

FIG. 8 is a plan view schematic of the subpixel matrix display of FIG. 4 with several row and column bus line defects or breaks therein; and

FIG. 9 is a plan view schematic of a subpixel matrix display of the invention similar to FIG. 8 with row and column bus line interconnections to avoid fatal defects caused by greater than one break in a particular row or bus column line.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now more particularly to FIG. 1, there is shown a schematic representation of an active matrix flat panel display device 10 made in accordance with conventional photolithographic techniques. One such device 10 and the manufacture thereof is more fully described in Application of Amorphous Silicon Field Effect Transistors in Addressable Liquid Crystal Display Panels, A. J. Snell, et al., *Applied Physics*, No. 24, p. 357, 1981. The device 10 includes a substrate 12, sets of contact pads 14 and 16, sets of control or bus lines 18 and 20, and, in this particular example of the prior art, transistors 22 and pixel back contacts 24.

The substrate 12 commonly employed in these devices is formed from glass. The control lines 18 and 20 are organized into a matrix of rows 18 and columns 20. The control line rows 18 in this device 10 serve as gate electrodes and the control line columns 20 as source connections. One contact pad 14 is connected to one end of each of the row control lines 18. One contact pad 16 is connected to one end of each of the column control lines 20. The display drive control (not shown) is connected to the sets of pads 14 and 16.

At each matrix crossover point 26, where a row line 18 and a column line 20 cross, a switching element, transistor 22 is formed to connect the row line 18 and column line 20 to the pixel back contacts 24. The active medium is deposited at least on the contacts 24 which will optically change properties in response to the combined voltages or currents in the respective crossover point 26 formed by the row 18 and column 20. The active medium at a given crossover point 26 will appear as a square or dot in the overall checkerboard type matrix of the display 10. The actual size of the transistors 22 and the contacts 24 are not now drawn to scale, but are shown schematically for illustration only.

It should be noted that theoretically there is no limit on the number of rows 18 and columns 20 that can be employed, only a portion of which are illustrated in FIG. 1. Therefore, there is also no theoretical limit on the outside dimensions of such a device 10. However, the present state of the lithographic art places a practical limit on the outside dimensions of these devices. The present alignment techniques generally allow high resolution display devices to be manufactured approximately five inches on a side 28, although improved techniques of up to fourteen inches on a side has been demonstrated.

The problem encountered by the prior art method of manufacture is that if the array of device 10 contains any defective pixel transistors 22 or other circuit elements causing a pixel to be inoperative, it must be discarded.

Referring in detail to FIG. 2, several problems occur when the switching element, transistor 22 is manufactured. The substrate 12 is a substantial portion of the backplane cost and hence an inexpensive soda-lime glass is generally utilized. It has been demonstrated by liquid crystal display manufacturers that the high sodium concentration can poison the liquid crystal material by diffusing through the overlying ITO layer and hence an SiO_2 suppression layer 30 is generally formed on the substrate 12. There are some high quality low sodium types of substrates available, which would not need the suppression layer 30. An ITO layer 32 is formed and etched to provide an ITO free area on which the gate 18 is deposited. Following the deposition of the gate 18, a gate insulator layer 34 is deposited. Although a smooth uniform coverage of the gate 18 by the insulator 34 is illustrated, in production the gate 18 has or can have sharp edges which lead to pin holes or thinning of the insulator 34 at the gate edges. The source and drain metals can short to the gate 18. The thinning or pin holes produce transistors 22, which if operative, do not have uniform operating characteristics and hence the backplane is worthless.

One attempt to solve this problem, is to make the gate 18 very thin, but the resistivity is then too high to make the large arrays necessary for the backplane. A second attempt to solve the problem is to make the gate insulator 34 very thick, but this decreases the gain of the transistor 22 and is also self defeating.

An amorphous silicon layer 36 is then deposited, with the source 20 and a drain 38 deposited thereover. A passivating layer (not shown) would be deposited over the completed structure to complete the transistor 22. During operation the activation of the source 20 and the gate 18 couples power through the silicon alloy 36 to the drain and hence to the contact pad 24 formed by the ITO layer 32.

Referring now to FIG. 3, there is shown a schematic representation of one embodiment of a transistor 40 which can be utilized with the present invention. The transistor is more fully disclosed in U.S. Pat. No. 4,545,112 and U.S. Ser. No. 493,523, which are incorporated herein by reference.

A glass substrate 42 includes a barrier SiO_2 layer 44 thereon. As above mentioned, a low sodium glass substrate, such as Corning 7059 glass, could be utilized, and hence the barrier layer 44 can be eliminated The detailed deposition steps are described in the above-

referenced patent and application. An ITO layer **46** is deposited and then a refractory metal layer **48** is deposited on the ITO layer **46**.

The layers **46** and **48** are etched to form a gate electrode **50**. A gate insulator **52** and a semiconductor material **54** are sequentially deposited over the gate **50**. The material **54** preferably is an amorphous silicon alloy. To avoid the possibility of any gate to source or drain shorts at gate edges **56**, a dielectric **58** is deposited over the gate **55**, the gate insulator **52** and the semiconductor **54**. The dielectric **58** is deposited to a sufficient thickness to ensure that no shorts or thin spots are formed between the edges **56** of the gate **50** and a source **60** and a drain **62** deposited thereover.

The dielectric **58** is etched away only on a substantially planar central region **64** of the semiconductor layer **54**. This insures uniform operating characteristics for the transistors **40** in the backplane array. A passivating layer **66** is deposited over the whole structure to complete the structure of the transistor **40**.

During all of the transistor processing steps, the refractory metal layer **48** remains over a pixel contact pad **68** upon which the active material of the pixel is deposited. As a final step, before the active medium (not shown) is added to the backplane to complete the display, the refractory metal is etched off of the pixel pad **68** leaving the ITO layer **46** exposed after all the processing has been completed.

Referring now to FIG. **4**, a subpixel matrix display of the present invention is designated generally by the reference numeral **70**. The subpixel matrix display **70** is illustrated as having each pixel subdivided into four subpixels, but the pixels could be subdivided into numerous other configurations such as two subpixels, two by four or six subpixels or in three subpixels for color applications. Each pixel **72** is subdivided into four subpixels **74**, **76**, **78** and **80** (only one pixel **72** is so numbered for illustration). As previously stated, the number of pixels is merely shown for illustration purposes and the display **70** could contain any desired number and configuration, square or rectangular.

A column (source) line or bus **82** connects the subpixels **74** and **78** and all other column subpixel pairs in one-half of each of the pixels to a column or source contact pad **84** at one edge of the display **70**. A second column (source) line or bus **86** connects the subpixels **76** and **80** and all other column subpixel pairs in the second half of each of the pixels to the column or source contact pad **84**. The bus lines **82** and **86** are interconnected (shorted) at or before the pad **84** and are interconnected (shorted) at the opposite ends by a line or short **88**.

A row (gate) line or bus **90** connects the subpixels **74** and **76** and all other row subpixel pairs in one-half of each of the pixels to a row (gate) pad **92**. A second row (gate) line or bus **94** connects the subpixels **78** and **80** and all other row subpixel pairs in one-half of each of the pixels to the row pad **92**. The bus lines **90** and **94** are interconnected (shorted) at or before the pad **92** and are interconnected (shorted) at the opposite ends by a line or short **96**.

In a like manner, each of the other subpixel pairs are connected in columns to respective column (source) pads **98** and **100**, etc. The pads **84**, **98** and **100** are illustrated as being on opposite sides of the display to provide additional connecting space for the pads, however, they also could all be on one side as in the display **10**. Each of the other subpixel pairs also are connected in rows to respective row (gate) pads **102** and **104**, etc.

The pixel **72** then is divided into four subpixels **74**, **76** **78** and **80** which allows for one of the subpixels to be defective, such as the subpixel **74**, without causing a fatal defect, since the remaining three subpixels **76**, **78** and **80** remain operative. In prior devices, the pixel **72** would be totally defective and hence the display **70** would be inoperable.

Further, one often fatal display defect is caused by a defect or open in one of the row or column bus lines which would cause the whole row or column to be out, again resulting in an inoperative display **70**. With the respective subpixel pairs of row and column bus lines interconnected, however, an open in a bus line will at most cause one subpixel to be inoperative. An open in one or more of the bus lines between the subpixels will result in no defects, since the current is supplied from the opposite shorted end of the row or column bus line. Thus, the display **70** in effect has redundant row and column bus lines.

Referring to FIG. **5**, a second embodiment of a subpixel matrix display of the present invention is designated generally by the reference numeral **106**. Again, a pixel **108** is subdivided into a plurality of subpixels **110**, **112**, **114** and **116**. In this embodiment, each of the subpixels **110**, **112**, **114** and **116** has a common column (source) line or bus **118** and a common row (gate) line or bus **120**. The column bus line **118** is coupled by a source line **122** to a line **124**, which is a schematic representation of a common source electrode. The row bus line **120** is coupled (schematically) by a line **126** to a line **128** which is a schematic representation of a gate electrode. Each of the subpixels **110**, **112**, **114** and **116** is coupled by a separate respective drain line **130** **132**, **134** and **136** to the (schematic) common source electrode **124**. Since the drain lines **130**, **132**, **134** and **136** are small and formed close to one another to utilize the least space, a short in one of the lines, such as the drain line **130** causes only the subpixel **110** to be defective.

A flat panel backplane testing configuration is generally designated by the numeral **138** in FIG. **6**. A flat panel backplane configuration **140** having subpixels similar to the display **70** of FIG. **4** includes a plurality of interconnected row (gate) lines or buses which are connected as described above to a plurality of row (gate) pads **142**, **144**, **146**, **148**, **150**, **152**, **154** and **156**.

Additionally, each of the row pads **142**, **144**, **146**, **148**, **150**, **152**, **154** and **156** and hence each of the row (gate) lines or buses is interconnected in a serpentine fashion by respective lines or shorts **158**, **160**, **162**, **164**, **166**, **168** and **170**. In addition, to allow the testing of the last pair of row lines from the row pad **156**, an additional or test row pad **172** is added to the test configuration **138**, which is coupled to the last pair of row bus lines by a line **174**.

Each of a pair of a plurality of interconnected column (source) lines or buses is connected to a respective column (source) pad **176**, **178**, **180**, **182**, **184** **186** **188** and **190** as described above. As with the row bus lines and pads, each column pad **176**, **178**, **180**, **182**, **184**, **186**, **188** and **190** is interconnected in a serpentine fashion by respective lines or shorts **192**, **194**, **196**, **198**, **200**, **202** and **204**. Again, to test the last pair of column bus lines, an additional or test column pad **206** is added to the test configuration **138**, which is coupled to the last pair of column bus lines by a line **208**.

As soon as the row bus lines (presuming the row bus lines are deposited first) are formed, all of the row bus lines can be tested merely by contacting two test points, the pads **142** and **172**. In a like manner, the column bus lines can be tested simultaneously by contacting the two pads **176** and **206**. The tests can be repeated as desired during the manufacturing process and appropriate repairs or termination of the manufacturing process can occur to reduce the manufacturing costs and to increase the yield of the completed display.

If the display is an inactive matrix without transistors or other active devices, then once the row and column bus lines have been tested as having continuity, then the serpentine interconnections are opened or broken to complete or allow completion of the display backplane. Preferably, especially where the devices are formed on glass, the interconnecting lines **158**, **160**, etc. and **192**, **194**, etc. extend beyond their respective pads, such that four scribe lines **210**, **212**, **214** and **216** intersecting all of the connecting lines can be formed. The glass substrate then is broken off along each of the scribe lines **210** **212**, **214** and **216** to terminate the test interconnections.

Where the subpixel display device **140** includes active devices, such as the transistors previously described, then the transistors also will be tested prior to terminating the interconnections. Further, if desired, the liquid crystal medium can be added and the whole display can be tested at once to see if all the pixels of the whole display **140** are operable prior to terminating the connections. In this case, one or both row pads **142** and **172** are contacted with an appropriate row or gate activation voltage.

In a like manner, one or both column pads **176** and **206** are contacted with an appropriate column or source activation voltage. Also, the backplane contact (not illustrated) is contacted with an appropriate activation voltage, which will activate all of the pixels for a visual test of the display device **140**

Referring to FIG. **7**, the prior art device **10** (FIG. **1**) is illustrated having a test configuration **218**. The row bus lines **18** are interconnected in a serpentine fashion by a plurality of connecting lines **220**, **222**, **224** and **226** (partially shown). Depending upon the number of bus lines, the device **10** may not need an additional test pad, since the device ends in a pad **228** on the last row bus line **230**. In a like manner, the column bus lines are interconnected in a serpentine fashion by a plurality of connecting lines **232**, **234** and **236**. If desired, or the configuration requires, a pair of column test pads **238** and **240** with respective connecting lines **242** and **244** are utilized to test the display **10** as described with respect to FIG. **6**, prior to terminating or removing the connecting lines. Generally, the device **10** would be configured with the column pads all on the same side as illustrated for the row pads.

Referring to FIG. **8**, a test configuration **246** with a subpixel display **248** is best illustrated, which is similar to the display **70** of FIG. **4**, with the serpentine test configuration of FIG. **6**. Like numerals for the like parts from those described in FIG. **4**, are utilized where appropriate. As described before, the redundant row bus lines **90** and **94** will provide the operating current to all the subpixels **74**, **76**, **74'**, **76'**, etc. if a single break or defect **250** occurs in one of the lines **90**. In that case the row bus lines for the subpixels **74**, **76** and **74'** are fed from the pad **92** on one end of the bus line **90**, while the subpixels **76'**, **74''** and **76''** are fed via the pad **92**, the bus line **94** across the short **96** and via the other end of the bus line **90**. If, however, a second break **252** occurs in the same bus line **90**, then no current will be fed to the subpixels **76'** and **74''**, which then are isolated. Two or more adjacent subpixels being inoperative generally would be a fatal defect and the redundant row bus lines **90** and **94** then would not be sufficient to save the display **248**. In a like manner, two or more breaks in any of the row or column bus lines or pairs of bus lines generally will render the display inoperative.

To avoid the fatal defect of the multiple open lines another redundant display configuration is designated generally by the numeral **254** in FIG. **9**. The redundant row and column bus lines are further interconnected in the display **254** at each subpixel to avoid the fatal defect illustrated in FIG. **8**.

The display **254** is illustrated only with the bus line and interconnection patterns without the subpixels for clarity. Each pair of the column bus lines **82** and **86** are additionally interconnected between each of the subpixels **74**, **78**, etc. by respective lines or shorts **256**, **256'** and **256''**. In a like manner, each pair of the row bus lines **90** and **94** are interconnected between each of the subpixels **74**, **76**, etc. by respective lines or shorts **258**.

With the additional interconnections **256** and **258**, the previously fatal double open defects **250** and **252** do not cause the loss of any subpixels. The subpixels **76'** and **74''** now are fed via the bus line **94** and the short connecting line **258'**. Therefore, the display **254** does not have any subpixel defects. Further, although both the row bus lines and the column bus lines have been illustrated as being interconnected between each subpixel, only one of the row or the column bus line sets might be shorted to limit the loss of active pixel display area.

Modification and variations of the present invention are possible in light of the above teachings. The transistors **22** or other types of two or three terminal switching devices can be utilized with the invention. The amorphous silicon alloy semiconductor material **54**, could be any of numerous types of materials such as CdSe or GaAs materials. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. A method of manufacturing matrix display backplanes and displays therefrom, comprising:

providing a substrate;

providing a pattern of pixels on said substrate; and

providing a plurality of sets of intersecting pixel activation bus lines and coupling each said pixel to a pair of said sets of intersecting bus lines to provide each pixel with a redundant pair of activation bus lines, including connecting each of said pixels to one of its redundant pair of activation bus lines and interconnecting each end of said redundant pair of activation bus lines to one another to provide said redundancy and dividing each pixel into a plurality of subpixels and connecting each of said subpixels to one of its redundant pair of activation bus lines through an active device, independent of any other pixel activation bus lines.

2. The method as defined in claim **1** including interconnecting each of said redundant pair of activation bus lines between each of said pixels.

3. The method as defined in claim **1** including providing a redundant pair of row activation bus lines and a

redundant pair of column activation bus lines for each of said pixels.

4. The method as defined in claim 3 including interconnecting at least one pair of said row and column lines between each of said pixels.

5. A display having dual bus lines, comprising:

a substrate;

a pattern of pixels formed on said substrate; and

a plurality of sets on intersecting pixel activation bus lines formed on said substrate and each said pixel coupled to a pair of said sets of intersecting bus lines to provide each pixel with a redundant pair of activation bus lines, including each of said pixels connected to one of its redundant pair of activation bus lines and each end of said redundant pair of activation bus lines interconnected to one another to provide said redundancy and each pixel divided into a plurality of subpixels and each of said subpixels connected to one of its redundant pair of activation bus lines through an active device, independent of any other pixel activation bus lines.

6. The display as defined in claim 5 including each of said redundant pair of activation bus lines interconnected between each of said pixels.

7. The display as defined in claim 5 including a redundant pair of row activation bus lines and a redundant pair of column activation bus lines connected to each of said pixels.

8. The display as defined in claim 7 including at least one pair of said row and column lines interconnected between each of said pixels.

9. A method of manufacturing matrix display backplanes and displays therefrom, comprising:

providing a substrate;

providing a pattern of pixels on said substrate;

providing a plurality of sets of intersecting pixel activation bus lines and coupling each said pixel to at least one of said sets of intersecting bus lines to provide each pixel with a set of activation bns lines;

forming said activation bus lines substantially orthogonal to one another in a plurality of rows and a plurality of columns of bus lines;

interconnecting opposite ends of each of said plurality of row bus lines in a serpentine fashion to serially connect substantially all of said row bus lines to one another;

interconnecting opposite ends of each of said plnrality of column bus lines in a serpentine fashion to serially connect substantially all of said column bus lines to one another;

testing the continuity of substantially all of said plurality of row and column bus lines by contacting only two test points on each of said interconnected row and column bus lines as the backplanes are being manufactured; and

terminating substantially all of said interconnections after said bus lines are tested as having continuity to complete the manufacture of the backplanes and displays therefrom.

10. The method as defined in claim 9 including providing a plurality of sets of intersecting pixel activation bus lines and coupling each said pixel to a pair of said sets of intersecting bus lines to provide each pixel with a redundant pair of activation bus lines and interconnecting opposite ends of each respective pair of said plurality of row and column bus lines to test the continuity of said sets of row and column bus lines.

11. The method as defined in claim 10 including connecting each of said pixels to one of its redundant pair of activation bus lines and interconnecting each end of said redundant pair of activation bus lines to one anotber to provide said redundancy.

12. The method as defined in claim 11 including dividing each pixel into a plurality of subpixels and connecting each of said subpixels to one of its redundant pair of activation bus lines.

13. The method as defined in claim 12 including interconnecting at least one pair of said row and column lines between each of said pixels.

14. A display backplane having interconnections, comprising

a substrate;

a pattern of pixels formed on said substrate;

a plurality of sets if intersecting pixel activation lines formed on said substrate and each said pixel coupled to at least one of said sets of intersecting lines by an active device to provide each pixel with a set of activation lines;

said activation lines formed substantially orthogonal to one another in a plurality of rows and a plurality of columns of lines;

opposite ends of each of said plurality of row lines interconnected in a serpentine fashion to serially connect substantially all of said row lines to one another;

opposite ends of each of said plurality of column bus lines interconnected in a serpentine fashion to serially connect substantially all of said column bus lines to one another; and

a pair of test points on each of said row and said column bus lines.

15. The backplane as defined in claim 14 including a plurality of sets of intersecting pixel activation bus lines, each said pixel coupled to a pair of said sets of intersecting bus lines to provide each pixel with a redundant pair of activation bus lines and opposite ends of each respective pair of said plurality of row and column bus lines interconnected.

16. The backplane as defined in claim 15 including each of said pixels connected to one of its redundant pair of activation bus lines and each end of said redundant pair of activation bus lines interconnected to one another to provide said redundancy.

17. The backplane as defined in claim 16 including each pixel divided into a plurality of subpixels and each of said subpixels connected by an active device to one of its redundant pair of activation bus lines.

18. The backplane as defined in claim 17 including at least one pair of said row and column lines interconnected between each of said pixels.

19. A method of manufacturing matrix display backplanes and displays therefrom, comprising:

providing a substrate;

providing a pattern of pixels on said substrate;

subdividing each of said pixels into at least two subpixels; and

providing a plurality of sets of intersecting subpixel activation bus lines and coupling each said subpixel to at least one of said sets of intersecting bus lines to provide each subpixel with a set of activation bus lines through an active device, independent of any other pixel activation bus lines.

20. The method as defined in claim 19 including connecting each of said subpixels to one of its redundant pair of activation bus lines and interconnecting each end

of said redundant pair of activation bus lines to one another to provide said redundancy.

21. The method as defined in claim **20** including interconnecting each of said redundant pair of activation bus lines between each of said subpixels.

22. The method as defined in claim **24** including interconnecting opposite ends of each of said plurality of row bus lines in a serpentine fashion to serially connect substantially all of said row bus lines to one another;

interconnecting opposite ends of each of said plurality of column bus lines in a serpentine fashion to serially connect substantially all of said column bus lines to one another:

testing the continuity of substantially all of said plurality of row and column bus lines by contacting only two test points on each of said interconnected row and column bus lines as the backplanes are being manufactured; and

terminating substantially all of said interconnections after said bus lines are tested as having continuity to complete the manufacture of the backplanes and displays therefrom.

23. The method as defined in claim **22** including testing all of said subpixels by contacting said two row and said two column bus line test points.

24. The method as defined in claim **19** including providing a redundant pair of row activation bus lines and a redundant pair of column activation bus lines for each of said subpixels.

25. The method as defined in claim **24** including interconnecting at least one pair of said row and column lines between each of said subpixels.

26. A display backplane having subpixels, comprising:

a substrate;

a pattern of pixels formed on said substrate;

each of said pixels subdivided into at least two subpixels; and

a plurality of sets of intersecting pixel activation bus lines formed on said substrate and each said subpixel coupled to at least one of said sets of intersecting bus lines to provide each subpixel with a set of activation bus lines through an active device, independent of any other pixel activation bus lines.

27. The display as defined in claim **26** including each of said subpixels connected to one of its redundant pair of activation bus lines and each end of said redundant pair of activation bus lines interconnected to on another to provide said redundancy.

28. The display as defined in claim **27** including each of said redundant pair of activation bus lines interconnected between each of said subpixels.

29. The display as defined in claim **27** including opposite ends of each of said plurality of row bus lines interconnected in a serpentine fashion to serially connect substantially all of said row bus lines to one another; and

opposite ends of each of said plurality of column bus lines interconnected in a serpentine fashion to serially connect substantially all of said column bus lines to one another.

30. The display as defined in claim **26** including a redundant pair of row activation bus lines and a redundant pair of column activation bus lines connected to each of said subpixels.

31. The display as defined in claim **30** including at least one pair of said row and column lines interconnected between each of said subpixels.

* * * * *

EXHIBIT 3

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

LG. PHILIPS LCD CO. LTD,	:	
	:	
Plaintiff,	:	
	:	
v.	:	Civil Action No. 05-292-JJF
	:	
TATUNG COMPANY, TATUNG COMPANY OF AMERICA, INC., CHUNGWHA PICTURE TUBES LTD., and VIEWSONIC CORP.,	:	
	:	
Defendants.	:	

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MEMORANDUM OPINION

June 13, 2006
Wilmington, Delaware

Farnan, District Judge:

Plaintiff L.G. Philips LCD Co., LTD ("LPL") filed this patent infringement action against Defendants Tatung Company, Tatung Company of America, Inc., Chungwha Picture Tubes, LTD., and ViewSonic Corporation (collectively "CPT"). LPL alleges that CPT has infringed U.S. Patent No. 5,019,002 ("the '002 patent"). LPL's Complaint (D.I. 1) also alleges infringement of U.S. Patent No. 6,738,121 ("the '121 patent"), but LPL has withdrawn all claims relating to that patent. (D.I. 180.) Presently before the Court is the claim construction dispute of the parties. The parties briefed their respective positions, and the Court held a Markman hearing on March 20, 2006. This Memorandum Opinion provides the Court's construction of the claim terms and phrases disputed by the parties.

BACKGROUND

The Patent at issue in this lawsuit relates to flat panel, display screens and methods of manufacturing them that include electrostatic discharge guard rings to protect the active elements of the display from electrostatic discharge during and after manufacturing. In their briefing and at the Markman hearing, the parties disputed twenty-six terms and phrases from the claims of both the '002 patent and the '121 patent. By its Order dated March 22, 2006 (D.I. 155), the Court ordered the parties to select a reduced number of terms and phrases to be

construed by the Court. The Court allowed LPL to submit a maximum of five terms or phrases and CPT a maximum of eight. (D.I. 155.) Following the parties' submissions of the terms and phrases to be construed, LPL filed a Notice Of Voluntary Withdrawal Of Claims Relating To U.S. Patent No. 6,738,121 (D.I. 180). As a result of that withdrawal and the fact that one claim term was submitted by both parties, there are currently six claim terms and phrases in dispute: "interconnecting," "outer electrostatic discharge guard ring," "resistance," "corner pad," "removing said outer guard ring and row and column interconnections," and "pickup pad."

DISCUSSION

I. Legal Principles Of Claim Construction

Claim construction is a question of law. Markman v. Westview Instruments, Inc., 52 F.3d 967, 977-78 (Fed. Cir. 1995), aff'd, 517 U.S. 370, 388-90 (1996). In interpreting a claim, a court should look first to the intrinsic evidence, i.e. the patent itself, including the claims and the rest of the specification, and, if in evidence, the prosecution history. Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582 (Fed. Cir. 1996). Although it is within the sound discretion of a court to use extrinsic evidence as an aid in construing a claim, extrinsic evidence is "unlikely to result in a reliable interpretation of patent claim scope unless considered in the

context of the intrinsic evidence." Phillips v. AWH Corp., 415 F.3d 1303, 1319 (Fed. Cir. 2005) (en banc).

A claim term should be construed to mean "what one of ordinary skill in the art at the time of the invention would have understood the term to mean." Markman, 52 F.3d at 986. However, "the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification." Phillips, 415 F.3d at 1313. Thus, the specification is usually "dispositive; it is the single best guide to the meaning of a disputed term." Id. at 1315 (quoting Vitronics, 90 F.3d at 1582). In other words, a claim term can be given its correct construction only within the context of "what the inventors actually invented and intended to envelop with the claim." Phillips, 415 F.3d at 1316.

II. Construction Of The Disputed Terms and Phrases

The language of independent claim 1 and dependent claims 3 and 7 is representative of the disputed terms and phrases. In full, claim 1 provides (emphasis added):

> 1. A method of manufacturing active matrix display backplanes and displays therefrom, comprising:
> providing a substrate;
> forming a pattern of pixels on said substrate;
> forming a plurality of row and column intersecting pixel activation lines, interconnecting substantially all of said row lines to one another and substantially all of said column lines to one another;
> forming an outer electrostatic discharge guard

> ring on said substrate coupled to said interconnected row and column lines via a resistance to provide protection from electrostatic discharges between said row and column activation lines during manufacture of the displays; and
>
> removing said outer guard ring and row and column interconnections prior to completion of the display.

('002 patent, col. 8, l. 65 - col. 9, l. 12.) In full, claim 3 provides (emphasis added): "3. The method as defined in claim 1 including forming at least one pickup pad coupled to said resistance via a shunt switching element." (Id. col. 9, ll. 16-18.) In full, claim 7 provides (emphasis added): "7. The method as defined in claim 1 including forming a corner pad on at least one corner of the display and aligning scribe lines with said corner pad for removing said outer guard ring and row and column intersections." (Id. col. 9, ll. 29-33.)

A. Construction of "Interconnecting"

LPL contends that the term "interconnecting" should be construed as "shorting." (D.I. 135 at 12.) LPL argues that "'interconnecting' was used throughout the entire intrinsic record in a manner consistent with this single meaning." (Id.) CPT contends that "shorting" is impermissibly vague because the specification uses that term in a variety of contexts. (D.I. 144 at 6.) CPT proposes instead the construction "electrically connecting with conductors." (D.I. 164 at 1.)

The Court agrees with CPT that LPL's proposed construction

is vague. Substituting "shorting" for "interconnecting" would not clarify the meaning of "interconnecting," but rather would make it more ambiguous. In the '002 patent's specification, "short" is used in at least four different ways: the path taken by an unintended, destructive discharge of a static potential ('002 patent, col. 2, ll. 57-62); a physical defect in electrical components resulting in an unintended current pathway (Id., col. 4, ll. 27-28); a deliberate re-routing of an electrostatic discharge via a shunt transistor (Id., col. 7, ll. 35-41); and a deliberate connection between electrical elements to provide an alternate current pathway (Id., col. 5, ll. 65-68). Only the last of these is consistent with LPL's proposed construction of "interconnecting".

LPL contends that CPT's proposed construction of "electrically connecting with conductors" improperly limits the term "interconnecting" to a single embodiment by specifying that the electrical connection must be made with conductors. (D.I. 158 at 2.) However, the consistent use of a claim term by the inventor in the specification may serve to limit the scope of a claim. Nystrom v. Trex Co., Inc., 424 F.3d 1136, 1145 (Fed. Cir. 2005). Here, CPT's proposed construction is consistent with the inventor's use of "interconnecting" throughout the '002 patent's

specification.[1] "Interconnecting" is consistently described or illustrated in figures as using "lines", "shorts", or "jumpers", i.e. conductors, to connect electrical elements. (See e.g., '002 patent, col. 5, ll. 65-68; col. 6, ll. 6-9; col. 6, ll. 42-43; col. 8, ll. 5-7.) Therefore, the Court will construe "interconnecting" to mean "electrically connecting with conductors."

B. Construction of "Removing Said Outer Guard Ring and Row and Column interconnections"

LPL contends that the phrase "removing said outer guard ring and row and column interconnections" does not require construction, but that the proper construction, if one is necessary, is "physically disconnecting said guard ring and row and column interconnections." (D.I. 135 at 23-24.) CPT's proposed construction is "electrically disconnecting the interconnections between rows and between columns, and electrically disconnecting rows and columns from the outer guard ring." (D.I. 137 at 12.) The Court agrees with LPL's construction.

The parties' dispute hinges on the meaning of "removing," with LPL contending that it means "physically disconnecting" and

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[1] Defendants' proposed construction is also consistent with the use of "interconnecting" in U.S. Patent 4,820,222 ("the '222 patent), which has the same inventor as the '002 patent and is incorporated by reference in the '002 patent. ('002 patent, col. 2, ll. 30-36.)

Defendants contending that it means "electrically disconnecting." CPT's construction depends on its assertion that "removing" means "removing a part or component from an electronic circuit." (D.I. 144 at 3; D.I. 138 at 9.) However, as it is used throughout the specification, "removing" is more logically interpreted as referring to the removal of the guard ring and row and column interconnections from the display panel. (See '002 patent, Abstract ("the external guard ring is removed prior to completion of the display"); col. 2, ll. 64-65 ("the external guard ring is removed at the end of the display manufacturing process"); col. 8, ll. 27-30 ("[t]he outer ESD guard ring . . . is removed prior to completion of the display").) Thus, the intrinsic evidence indicates that "removing" is used to mean physical disconnection and separation such that the outer guard ring and row and column interconnections are not included in the finished display panel. Therefore, the Court will construe "removing said outer guard ring and row and column interconnections" as "physically disconnecting said guard ring and row and column interconnections."

C. Construction of "Outer Electrostatic Discharge Guard Ring"

LPL's proposed construction of the phrase "outer electrostatic discharge guard ring" is "a closed or open ring, or open L or C-shaped line, outside the active matrix display to provide protection from electrostatic discharges." (D.I. 158 at

2.) CPT's proposed construction is "a ring of conductor, located external to the inner electrostatic discharge guard ring if the two rings are used together, for draining off electrostatic buildup to prevent electrostatic discharge." CPT does not dispute that the outer guard ring is "a closed or open ring, or open L or C-shaped line." (D.I. 144 at 6.) The parties do dispute whether the guard ring functions to prevent electrostatic discharge ("ESD") or only to protect against damage caused by ESD.[2] The parties also dispute the meaning of "outer."

The specification consistently refers to the function of the ESD guard rings as protecting the active elements of the display from ESD rather than preventing ESD altogether. (See '002 patent, Abstract ("At least one ESD guard ring is provided to protect the active elements of the display from the potential discharge between the row and column lines."); col. 2, ll. 61-61 ("An external guard ring can be formed, which provides protection during manufacture of the displays . . ."); col. 8, ll. 27-29 ("The outer ESD guard ring provides ESD protection only during manufacture of the display . . .").) CPT points out that the specification uses the word "prevent" or "preventive" to describe the function of the ESD rings. (D.I. 164 at 4.) However, in

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[2] CPT refers to this dispute as "insignificant," but, nevertheless, maintains the position that the proper construction refers to prevention of ESD rather than protection from ESD. (D.I. 164 at 4.)

both of the locations cited, the specification is referring to the prevention of damage caused by ESD rather than to the prevention of ESD itself.

The central dispute over the phrase "outer electrostatic discharge guard ring" is whether "outer" is used in reference to an inner ESD ring or to the entire display panel. CPT contends that "outer" must refer to the outer guard ring's position relative to the inner guard ring. (D.I. 137 at 8.) This contention is untenable. Independent claims 1 and 19 include an outer ESD guard ring, but no inner ESD guard ring. In the context of those claims, CPT's proposed construction would render the adjective "outer" meaningless.

On the other hand, LPL contends that "outer" refers to the outer guard ring's position relative to the active matrix display. CPT concedes that "active matrix display" as used in the '002 patent and in LPL's proposed construction means the entire finished display panel. (D.I. 164 at 3.) CPT argues that the Court should reject LPL's proposed construction because it is based on "the erroneous notion that the outer ring must be physically removed at the end of the manufacture." (Id.) As the Court concluded in section II.B. above, however, the intrinsic evidence indicates that physical removal of the outer guard ring is precisely what the patent teaches. Therefore, the Court will construe "outer electrostatic discharge guard ring" as "a closed

or open ring, or open L or C-shaped line, outside the active matrix display to provide protection from electrostatic discharges."

D. Construction of "Resistance"

The parties agree that one of ordinary skill in the art would understand "resistance" to mean a physical property of a material or device characterized by opposition to the flow of electric current. (D.I. 135 at 13; D.I. 137 at 9.) They also agree that in the '002 patent, "resistance" is used to denote a circuit component. (D.I 135 at 13; D.I. 160 at 2.) LPL contends that because "[a]ll circuit components . . . have the characteristic of resistance," the Court should construe "resistance" as "any component used to cause a voltage drop during current flow." (D.I. 135 at 13.) CPT's proposed construction is "[a] resistance, as it is used in the claims, means a resistor, which is a circuit element that has a specified resistance to the flow of electrical current. A resistance does not include switching elements such as transistors and diodes." (D.I. 137 at 9.)

LPL's proposed construction cannot be correct because, as CPT points out, (D.I. 137 at 12), it would exclude the single preferred embodiment that incorporates a "resistance." (See '002 patent, col. 8, ll. 1-48.) The only purposes stated for the "resistance" in that embodiment are to provide an "ESD short for

high electrostatic potentials . . . ," (Id., col. 8, l. 31), and to minimize "the discharge current surge . . .," (Id., col. 8, l. 35). Thus, "resistance" as used in that embodiment, would not fall within the scope of LPL's proposed construction of "any component used to cause a voltage drop during current flow." A claim construction that excludes a preferred embodiment "is rarely, if ever, correct and would require highly persuasive evidentiary support. . . ." Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1583 (Fed. Cir. 1996) (citations omitted). The Court finds no such evidentiary support in this case.

On the other hand, CPT's proposed construction unnecessarily limits "resistance" to one specific electric component, a resistor. There is no support in the intrinsic record for such a narrow interpretation. Moreover, a person skilled in the art would certainly understand the meaning of "resistor" so it is logical to conclude that the inventor would have chosen that term had he intended to refer only to that specific component.

LPL correctly notes, (D.I. 163 at 3), that it is improper to import limitations from a preferred embodiment into the claims. See JVW Enterprises, Inc. v. Interact Accessories, Inc., 424 F.3d 1324, 1335 (Fed. Cir. 2005). However, "there is sometimes a fine line between reading a claim in light of the specification, and reading a limitation into the claim from the specification." Phillips v. AWH Corp., 415 F.3d 1303, 1323 (Fed.

Cir. 2005) (quoting Comark Communications, Inc. v. Harris Corp., 156 F.3d 1182, 1186-87 (Fed. Cir. 1998)). Here, because "resistance" is used in the claims in a manner somewhat different from its ordinary meaning to one of skill in the art, the only guidance as to how the Court should construe the term is how it is used in the single embodiment in which it appears. That embodiment mentions a "resistance" three times:

> The [ESD guard ring] line **210** is connected to the other set of gate or source lines by a shunt line **224**, a shunt transistor **226** and a large resistance **228**, such as 100 K ohms (illustrated schematically). . . . The resistance provides an ESD short for high electrostatic potentials which can be incurred during manufacturing . . . . The resistance minimizes the discharge current surge . . . .

('002 patent, col. 8, ll. 23-34.) In the claims, the term "resistance" is used consistently to denote only a circuit component used to couple the outer ESD guard ring to the interconnected row and column lines and the pickup pad. (See e.g. Id., col. 9, ll. 63-65; col. 10, ll. 6-8.)

Reading the claims in light of the specification, which describes the "resistance" only in general terms, the Court concludes that the patentee intended the claims and this embodiment in the specification to be coextensive at least in regard to the term "resistance".[3] Therefore, the Court will

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[3] The Court also notes that the patentee explicitly stated that certain elements of the invention could vary from the specific descriptions in that embodiment, but did not include the "resistance" among those elements. ('002 patent, col. 8, ll. 49-

construe "resistance" as "a circuit component that has a specified resistance to the flow of electric current and is used to minimize the current surge from an electrostatic discharge."

E. Construction of "Corner Pad"

LPL contends that the term "corner pad" does not require construction, but that the proper construction, if one is necessary is "a reference mark for cutting" (D.I. 135 at 24.) CPT contends that the Court should construe "corner pad" as "a pad of metal or other conductive materials that is located at the corner of an outer guard ring, and electrically connected with the outer ring" (D.I. 137 at 15.) CPT argues, (Id.), and LPL does not dispute, that "corner pad" has no inherent meaning to one of ordinary skill in the art and thus can be understood only within the context of the '002 patent's claims and specification. LPL does concede that "[o]ne of ordinary skill in the art would understand the term 'pad' to be a conductive area." (D.I. 135 at 15; D.I. 143 at 15.)

The term "corner pad" appears in only one embodiment in the specification. (See '002 patent, col. 8, ll. 1-48.) That embodiment describes three features of a "corner pad." First, it is connected to each other corner pad by conductive lines of the outer guard ring. (Id., col. 8, ll. 8-11.) Second, it can be grounded. (Id., col. 8, ll. 11-12.) Third, it provides

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62.)

alignment for the scribe lines. (Id., col. 8, ll. 12-15.) The second feature is explicitly optional, so it need not be included in the Court's construction. The third feature is specifically claimed, so it too need not be included in the Court's construction. (See, e.g., Id., col. 9, ll. 29-33 ("7. The method as defined in claim **1** including forming a corner pad on at least one corner of the display and aligning scribe lines with said corner pad for removing said outer guard ring and row and column intersections.")) Therefore, the Court concludes that LPL's proposed construction of "a reference mark for cutting" is unnecessary and would be redundant. The location of the corner pad is also specifically claimed as being "on at least one corner of the display." (See, e.g., Id., col. 9, l. 30.) Thus CPT's inclusion of "located at the corner of an outer guard ring" in its proposed construction is both unnecessary and inaccurate.

The remaining issue is whether the "corner pad" must be electrically connected to the outer guard ring. CPT bases its contention that the "corner pad" must be "electrically connected with the outer ring" on a single sentence from the specification: "A corner pad **208** is connected to each other corner pad (not illustrated) by respective outer conductive lines **210** and **212** of the guard ring **200**." (Id., col. 8, ll. 8-11.) The Court concludes that it would be improper to import this limitation from the specification into the claims. Therefore, to the extent

that "corner pad" requires construction, the Court will construe it as "an area of conductive material."

F. Construction of "Pickup Pad"

LPL's proposed construction of "pickup pad" is "a conductive area used to electrically connect the back plane to the front plane" (D.I. 135 at 14.) CPT's proposed construction is "a pad located at the corner region of a backplane for aligning the frontplane and backplane" (D.I. 137 at 13.) CPT contends, and LPL does not dispute, that the term "pickup pad" has no inherent meaning to one of ordinary skill in the art, and thus, can be understood only within the context of the intrinsic evidence. (D.I. 137 at 13.) The parties agree, however, that "pad" would be understood by one of ordinary skill in the art to mean a conductive area. (D.I. 135 at 15; D.I. 143 at 15; D.I. 160 at 3.) The Court concludes that neither proposed construction is appropriate and will decline to construe "pickup pad."

LPL's contention that the "pickup pad" is used to electrically connect the back plane to the front plane has no support in the intrinsic evidence. Neither the specification nor the claims of the '002 patent mentions any electrical connection between the front plane and the back plane via the "pickup pad". Both teach only the electrical connection of the "pickup pad" with other elements on the back plane. Thus, LPL's proposed construction cannot be correct.

CPT's proposed construction would violate the doctrine of claim differentiation. In this context, claim differentiation "refers to the presumption that an independent claim should not be construed as requiring a limitation added by a dependent claim." Curtiss-Wright Control Corp. v. Velan, Inc., 438 F.3d 1374, 1380 (Fed. Cir. 2006) (citing Nazomi Communications, Inc. v. Arm Holdings, PLC., 403 F.3d 1364, 1370 (Fed. Cir. 2005)). In the '002 patent, claim 5 depends from claim 3.[4] Claim 3 claims "[t]he method as defined in claim **2** including forming at least one pickup pad coupled to said resistance via a shunt switching element." ('002 patent, col. 9, ll. 16-18.) Claim 5 claims "[t]he method as defined in claim **3** including forming a corner on the said pad to align the front plane and back plane of the display." (Id., col. 9, ll. 23-25.) To construe "pickup pad" as CPT proposes, as "a pad . . . for aligning the frontplane and backplane," would be to read the limitation from claim 5 into claim 3, rendering claim 5 superfluous and violating the doctrine of claim differentiation.

All of the significant attributes of the "pickup pad" mentioned in the specification are also specifically claimed. (Compare, '002 patent, col. 8, ll. 18-39, with id. col. 9, ll. 16-28.) Therefore, the Court concludes that no further

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[4] The discussion that follows applies identically to claims 16 and 14, 23 and 21, and 34 and 32.

construction of the term "pickup pad" is necessary.

CONCLUSION

An Order consistent with this Memorandum Opinion will be entered setting forth the meaning of the disputed terms and phrases in the '002 patent.

EXHIBIT 4

ANSI/IEEE Std 100-1988
Fourth Edition

IEEE Standard Dictionary of Electrical and Electronics Terms

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residual induction (1) (magnetic material). The magnetic induction corresponding to zero magnetizing force in a material that is in a symmetrically cyclically magnetized condition. 210

(2) (residual flux density) (toroidal magnetic amplifier cores). The magnetic induction at which the magnetizing force is zero when the magnetic core is cyclically magnetized with a half-wave sinusoidal magnetizing force of a specified peak magnitude. *Note:* This use of the term **residual induction** differs from the standard definition that requires symmetrically cyclically magnetized conditions. 165

residual magnetism (ferromagnetic bodies). A property by which they retain a certain magnetization (induction) after the magnetizing force has been removed. 244, 210

residual modulation. *See:* **carrier noise; carrier noise level.**

residual probe pickup (constancy of probe coupling) (slotted line). The noncyclical variation of the amplitude of the probe output over its complete range of travel when reflected waves are eliminated on the slotted section by proper matching at the output and the input, discounting attenuation along the slotted section. It is defined by the ratio of one-half of the total variation to the average value of the probe output, assuming linear amplitude response of the probe, at a specified frequency(ies) within the range of usage. *Note:* This quantity consists of two parts of which one is reproducible and the other is not. The repeatable part can be eliminated by subtraction in repeated measurements, while the nonrepeatable part must cause an error. The residual probe pickup depends to some extent on the insertion depth of the probe. *See:* **measurement system; residual standing-wave ratio.** 185

residual reflected coefficient (reflectometer). The erroneous reflection coefficient indicated when the reflectometer is terminated in reflectionless terminations. *See:* **measurement system.** 185

residual relay (power switchgear). A relay that is so applied that its input, derived from external connections of instrument transformers, is proportional to the zero-phase-sequence component of a polyphase quantity. 103

residual response (1) (non-real time spectrum analyzer). A spurious response in the absence of an input. 68

(2) (spectrum analyzer). A spurious response in the absence of an input, not including noise and zero pip. 390

residual standing-wave ratio (SWR) (slotted line). The standing-wave ratio measured when the slotted line is terminated by a reflectionless termination and fed by a signal source that provides a nonreflecting termination for waves reflected toward the generator. *Note:* Residual standing-wave ratio does not include the residual noncyclical probe pickup or the attenuation encountered as the probe is moved along the line. *See:* **residual probe pickup.** 185

residual voltage (1) (arrester) (discharge voltage). The voltage that appears between the line and ground terminals of an arrester during the passage of discharge current. *See:* **inductive coordination.** 308, 62

(2) (protective relaying). The sum of the three line-to-neutral voltages on a three-phase circuit. 128

residue check (computing systems). A check in which each operand is accompanied by the remainder obtained by dividing this number by n, the remainder then being used as a check digit or digits. *See:* **modulo *n* check.** 255, 77

resin (rotating machinery). Any of various hard brittle solid-to-soft semisolid amorphous fusible flammable substances of either natural or synthetic origin: generally of high molecular weight, may be either thermoplastic or thermosetting. 63

resin-bonded paper-insulated bushing (outdoor electric apparatus). A bushing in which the major insulation is provided by paper bonded with resin. 168

resist (electroplating). Any material applied to part of a cathode or plating rack to render the surface nonconducting. *See:* **electroplating.** 328

resistance (1) (network analysis). (A) That physical property of an element, device, branch, network, or system that is the factor by which the mean-square conduction current must be multiplied to give the corresponding power lost by dissipation as heat or as other permanent radiation or loss of electromagnetic energy from the circuit. (B) The real part of impedance. *Note:* Definitions (A) and (B) are not equivalent but are supplementary. In any case where confusion may arise, specify definition being used. *See:* **resistor.** 210, 185, 206

(2) (shunt). The quotient of the voltage developed across the instrument terminals to the current passing between the current terminals. In determining the value, account should be taken of the resistance of the instrument and the measuring cable. The resistance value is generally derived from a direct-current measurement such as by means of a double Kelvin bridge. *See:* **test voltage and current.** 307

(3) (automatic control). A property opposing movement of material, or flow of energy, and involving loss of potential (voltage, temperature, pressure, level). 56

(4) (antenna). *See:* **antenna resistance; radiation resistance.**

resistance, apparent (insulation testing). Ratio of the voltage across the electrodes in contact with the specimen to the current between them as measured under the specified test conditions and specified electrification time. 97

resistance box. A rheostat consisting of an assembly of resistors of definite values so arranged that the resistance of the circuit in which it is connected may be changed by known amounts. 210

resistance braking. A system of dynamic braking in which electric energy generated by the traction motors is dissipated by means of a resistor. *See:* **dynamic braking.** 328

resistance bridge smoke detector (fire protection devices). A device which responds to an increase of

EXHIBIT 5

RANDOM HOUSE WEBSTER'S COLLEGE DICTIONARY

Random House
New York

The first edition of this work was published in 1991. Subsequent revisions were published in 1992, 1995, and 1996. This current edition has been completely redesigned, revised, updated, and retypeset for publication.

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Lincolnesque (lingˈkə nesk′), *adj.* like or characteristic of Abraham Lincoln. [1920–25]

Lincoln green′, *n.* an olive-green color. [1500–10; so called from color of a fabric orig. made in LINCOLN, England]

Lincoln's Birth′day, *n.* 1. February 12, a legal holiday in some of the U.S., in honor of the birth of Abraham Lincoln. 2. PRESIDENTS' DAY.

Lincoln•shire (ling′kən shēr′, -shər), *n.* a county in E England. 5500 sq. mi. (5885 sq. km). Also called **Lincoln.**

Lind (lind), *n.* **Jenny** (*Johanna Maria Lind Goldschmidt*) (*"The Swedish Nightingale"*), 1820–87, Swedish soprano.

lin•dane (lin′dān), *n.* a white, crystalline, water-insoluble powder, $C_6H_6Cl_6$, used chiefly as an insecticide, delouser, and weed-killer. [1945–50; after T. van der *Linden*, 20th-cent. Dutch chemist; see -ANE]

Lind•bergh (lind′bûrg, lin′-), *n.* **Charles Augustus,** 1902–74, U.S. aviator; made the first solo nonstop transatlantic flight 1927.

lin•den (lin′dən), *n.* 1. any tree of the genus *Tilia*, as *T. americana*, of North America, having fragrant yellowish white flowers and heart-shaped toothed leaves. 2. the soft, light, white wood of any of these trees. Compare BASSWOOD. [1570–80; n. use of obs. *linden* (adj.) of the lime, ME, OE = *lind(e)* linden (c. ON *lind*) + *-en* -EN²]

Linden fam′ily, *n.* a family, Tiliaceae, of trees, shrubs, or herbaceous plants, with simple leaves, fibrous bark, fragrant flowers, and woody fruit; includes the basswood, jute, and linden.

Lind•is•farne (lind′əs färn′), *n.* HOLY ISLAND (def. 1).

Lind•ley (lind′lē, lin′-), *n.* John, 1799–1865, English botanist.

Lin•dsay (lind′zē, lin′-), *n.* (Nicholas) Vachel (vā′chəl), 1879–1931, U.S. poet.

lin•dy (lin′dē), *n., pl.* **-dies.** an energetic jitterbug dance. Also called **Lindy hop′.** [1930–35; prob. from nickname of Charles A. LINDBERGH]

line¹ (līn), *n., v.,* **lined, lin•ing.** —*n.* 1. a long mark of very slight breadth, made with a pencil, tool, etc., on a surface. 2. a continuous extent of length, straight or curved, without breadth or thickness, the trace of a moving point. 3. something arranged along a line, as a straight line; a row: *a line of trees.* 4. a number of persons standing one behind the other and waiting their turns at or for something; queue. 5. something resembling a traced line, as a seam or furrow: *lines of stratification in rock.* 6. a furrow or wrinkle on the face, neck, etc. 7. an indication of demarcation; boundary; limit: *the county line; a fine line between right and wrong.* 8. a row of written or printed letters, words, etc. 9. a unit in the metrical structure of a poem or lyric, composed of feet. 10. Usu., lines. the words of an actor's part in a drama, musical comedy, etc. 11. a short written message: *Drop me a line when you're on vacation.* 12. a system of public conveyances, as buses or trains, plying regularly over a fixed route. 13. a transportation company: *a steamship line.* 14. a course of direction; route: *the line of march.* 15. a course of action, procedure, thought, policy, etc.: *That newspaper follows a conservative line.* 16. a piece of pertinent or useful information: *I've got a line on a good used car.* 17. a series of generations of persons, animals, or plants descended from a common ancestor: *a line of kings.* 18. a person's occupation or business: *What line are you in?* 19. *Informal.* a mode of conversation intended to impress or influence: *He handed us a line about his rich relatives.* 20. outline or contour: *a ship of fine lines.* 21. lines, a. a plan of construction, action, or procedure: *two books written along the same lines.* b. *Chiefly Brit.* a certificate of marriage. 22. a circle of the celestial or celestial sphere: *the equinoctial line.* 23. *Art.* a. a mark made by a pencil, brush, or the like, that defines the contour of a figure, forms hatching, etc. b. the edge of a shape. 24. a. a telephone connection: *Please hold the line.* b. a wire circuit connecting two or more pieces of electric apparatus, esp. the circuit connecting points or stations in a telegraph or telephone system or the system itself. 25. a stock of goods of the same general class but having a range of styles, sizes, prices, or quality. 26. an assembly line. 27. *Law.* a limit defining one estate from another; the outline or boundary of a piece of real estate. 28. (in bridge) a line on a score sheet below which points are scored toward game and above which bonus points are scored. 29. *Music.* any of the straight, horizontal, parallel strokes of the staff, or one placed above or below the staff. 30. a. a series of fortifications: *the Maginot line.* b. Often, lines. a distribution of troops, ships, etc., arranged for defense or drawn up for battle: *behind enemy lines.* c. the combatant forces of an army or navy, or their officers. 31. a body or formation of troops or ships drawn up abreast (distinguished from *column*). 32. that part of an administrative organization consisting of persons actively engaged on a given project. 33. a thread, string, cord, rope, etc. 34. a clothesline. 35. a cord, wire, etc., used for measuring or as a ruler. 36. a pipe or hose: *a steam line.* 37. a rope or cable used at sea. 38. *Slang.* a small quantity of cocaine arranged in the form of a slender thread, as for sniffing. 39. a cord or string with a hook, sinker, float, etc., for catching fish. 40. a. either of the two front rows of opposing football players lined up opposite each other on the line of scrimmage. b. LINE OF SCRIMMAGE. 41. the betting odds established by bookmakers for events not covered by pari-mutuel betting, esp. sporting events, as football or basketball. 42. the two wings and center that comprise an ice hockey team's offensive unit. —*v.t.* 43. to mark with a line or lines. 47. to form a line along: *Rocks lined the drive.* 48. to apply liner to (the eyes). 49. to delineate with or as if with lines; draw: *to line a silhouette.* 50. line out, a. *Baseball.* to be put out by hitting a line drive caught on the fly by a player of the opposing team. b. *Informal.* to execute or perform: *to line out a song.* 51. line up, to secure; make available. —*Idiom.* 52. down the line, a. in every way; thoroughly. b. in the future. 53. draw the line, to impose a restriction or limit. 54. hold the line, to maintain the status quo, esp. in order to forestall unfavorable developments. 55. in (the) line of duty, in the execution of one's duties, esp. with regard to the responsibility for life and death. 56. lay it on the line, *Informal.* to impart information directly and frankly. 57. off line, a. occurring or functioning away from the central work location, as an assembly line. b. not in operation; not functioning. c. not actively linked to a computer or central computer. 58. on line, a. on or part of an assembly line. b. in or into operation. c. actively linked to a computer. 59. on the line, a. in a vulnerable position. b. during the transaction; immediately: *to pay cash on the line.* 60. out of line, a. not in a straight line. b. disrespectful; presumptuous. [bef. 1000; ME *li(g)ne*, partly < OF *ligne* (< L *linea*, orig. n. use of fem. of *lineus* flaxen < *lin(um)* flax (see LINE²)] —**lin′•a•ble, line′a•ble,** *adj.*

line² (līn), *v.,* **lined, lin•ing.** —*v.t.* 1. to cover the inner side or surface of: *to line a coat with blue silk.* 2. to cover: *Bookcases lined the walls.* 3. to furnish or fill: *to line shelves with provisions.* 4. to reinforce (the back of a book) with glued fabric, paper, vellum, etc. [1350–1400; ME *lynen*, der. of *line* linen, flax, OE *līn* < L *linum* flax]

lin•e•age¹ (lin′ē ij), *n.* 1. lineal descent from an ancestor; ancestry. 2. the line of descendants of a particular ancestor; family; race. [1275–1325; ME *linage* < AF; OF *lignage* < VL **lineāticum;* see LINE¹, -AGE]

lin•e•age² (lī′nij), *n.* LINAGE.

lin•e•al (lin′ē əl), *adj.* 1. being in the direct line, as a descendant or ancestor, or in a direct line, as descent or succession. 2. of or transmitted by lineal descent. 3. LINEAR. [1350–1400; ME < LL *līneālis;* see LINE¹, -AL¹] —**lin′e•al•ly,** *adv.*

lin•e•a•ment (lin′ē ə mənt), *n.* 1. Often, lineaments. a feature or detail of a face, body, or figure, considered with respect to its outline or contour. 2. Usu., lineaments. distinguishing features. 3. a linear topographic feature of regional extent that is believed to reflect underlying crustal structure. [1400–50; < L *līneāmentum* a stroke = *līneā(re)* to draw a line + *-mentum* -MENT] —**lin′e•a•men′tal** (-mən′tl), *adj.*

lin•e•ar (lin′ē ər), *adj.* 1. of, consisting of, or using lines: *linear design.* 2. pertaining to or represented by lines: *linear dimensions.* 3. extended or arranged in a line: *a linear series.* 4. involving measurement in one dimension only. 5. of or pertaining to the characteristics of a work of art defined chiefly in terms of line. 6. having the form of or resembling a line: *linear nebulae.* 7. *Math.* a. consisting of, involving, or describable by terms of the first degree. b. having the same effect on a sum as on each of the summands: *a linear operation.* 8. narrow and elongated. [1635–45; < L *līneāris;* see LINE¹, -AR¹] —**lin′e•ar′i•ty,** *n.* —**lin′e•ar•ly,** *adv.*

Linear A, *n.* an ancient system of writing, not yet deciphered, inscribed on clay tablets, pottery, and other objects found at Minoan sites on Crete and other Greek islands. [1905–10]

lin′ear accel′erator, *n.* an accelerator in which particles are propelled in straight paths by the use of alternating electric voltages.

Linear B, *n.* an ancient system of writing used for Mycenaean Greek, deciphered chiefly from clay tablets found at Knossos and Pylos.

lin′ear equa′tion, *n.* a first-order equation involving two variables: its graph is a straight line in the Cartesian coordinate system.

lin′ear meas′ure, *n.* any system for measuring length, or any unit used in such a system. [1865–90]

lin′ear perspec′tive, *n.* a graphic system for representing depth and volume on a flat surface by means of lines converging at a point or points on a horizon. [1835–45]

lin•e•a•tion (lin′ē ā′shən), *n.* 1. an act or instance of marking with or tracing by lines. 2. a division into lines. 3. an outline or delineation. 4. an arrangement or group of lines. [1350–1400; ME < LL]

line•back•er (līn′bak′ər), *n.* 1. a football player on defense who takes a position behind the linemen. 2. the position played by this player.

line•breed•ing (līn′brē′ding), *n.* a form of inbreeding directed at keeping the offspring closely related to a superior ancestor. [1875–80]

line′ cut′, *n.* an engraving consisting only of lines or areas that are solid black or white. Compare HALFTONE (def. 2). [1900–05]

line′ draw′ing, *n.* a drawing done exclusively in line.

line′ drive′, *n.* a batted baseball that travels low, fast, and straight. Also called **liner.** [1930–35]

line′ engrav′ing, *n.* an engraving in which all effects are produced by variations in the width and density of lines incised with a burin.

Line′ Is′lands, *n.pl.* a group of 11 coral atolls in the central Pacific, S of Hawaii: eight of the islands belong to Kiribati, and three to the U.S.

line′-i′tem ve′to, *n.* the power, as of a state governor, to veto particular items of a bill without having to veto the entire bill. Also called **item veto.**

line•man (līn′mən), *n., pl.* **-men.** 1. a person who installs or repairs telephone, telegraph, or other wires. 2. one of the players in the defensive line of a football team, as a center, guard, tackle, or end. [1855–60]

line′man's pli′ers, *n.* (*used with a sing. or pl. v.*) pliers with reinforced pincers and insulated handles, used by electricians in working with cable and other heavy wires.

…′), *n.* **1.** a coat worn over the ordinary indoor …eather. **2.** Also called **o′ver•coat′ing**, an added …plied for protection. [1795–1805]

…um′), *v.*, **-came, -come, -com•ing.** …struggle or conflict. **2.** to prevail over (opposi… …ations, etc.). **3.** to overpower or overwhelm (a… *ne by smoke.* —*v.i.* **4.** to gain the victory; win. …**o′ver•com′er,** *n.* —**Syn.** See DEFEAT.

…r kə mit′), *v.t.*, **-mit•ted, -mit•ting.** to commit … desirable, or necessary. [1950–55]

…(ō′vər kom′pən sāt′), *v.*, **-sat•ed, -sat•ing.** …e excessively. —*v.t.* **2.** to perform more strenuo… …o overcome a defect. [1760–70] —**o′ver•com′…**

…n′sə tôr′ē, -tōr′ē), *adj.*

…on (ō′vər kom′pən sā′shən), *n.* **1.** compensa… …r or unreasonable degree. **2.** *Psychoanal.* a pro… …vercome a trait perceived as unacceptable by … trait. [1915–20; as psychoanalytic term; trans… …t, coined by Alfred Adler]

…roud′), *v.t., v.i.* to crowd to an uncomfortable … [1760–70]

…ər di vel′əp), *v.t.* **1.** to develop to excess. **2.** to …) for too long or in too strong a solution. —…

…*v.*, **-did, -done, -do•ing.** —*v.t.* **1.** to do to ex… …, to carry to excess or beyond the proper limit; … *ith the boss.* **3.** to overact (a part); exaggerate… …gth of; exhaust. **5.** to overcook. —*v.i.* **6.** to do … …ies. [bef. 1000] —**o′ver•do′er,** *n.*

…dōs′; *v.* ō′vər dōs′, ō′vər dōs′), *n.*, *v.*, **-dosed, …** …cessive dose of a drug. —*v.i.* **2.** to take an ex… …narcotic. —*v.t.* **3.** to give an excessive dose to.

…aft′, -dräft′), *n.* **1.** an act of overdrawing a … a check overdrawn on an account. **2.** the … an excessive drawing on or drawing out of … …ade to pass over a fire. [1875–80]

…ō′), *v.*, **-drew, -drawn, -draw•ing.** —*v.t.* **1.** to … …nt, allowance, etc.) in excess of the balance … or at one's disposal. **2.** to strain, as a bow; by … exaggerate in depicting or describing. —*v.i.* **3.** … : or the like. [1325–75] —**o′ver•draw′er,** *n.*

…dres′; *n.* ō′vər dres′), *v.t., v.i.* **1.** to dress with … …ality. **2.** to dress with too much clothing, … …other. [1700–10]

…drīv′; *v.* ō′vər drīv′), *n.* **1.** a device in a motor … …ear that provides a drive shaft speed greater … …aft speed. **2.** a state of intense activity. …b′; *n.* ō′vər dub′), *v.*, **-dubbed, -dub•bing,** *n.* …nal sound or music to an existing recording … …d to a recording. —*n.* **3.** an act of overdubbing. …r layer of sound integrated into a recording. …**-dyōō′**), *adj.* **1.** past due, as a delayed train or … …signed date; late. **2.** too long awaited. **3.** more … …ed or ready.

…n egg) fried on one side until nearly done and … reverse side.

…*v.i.*, **-ate, -eat•en, -eat•ing.** to eat too much … …er, *n.*

…ō′vər es′tə māt′), *n.* ō′vər es′tə mit), … —*v.t.* **1.** to estimate at too high a value, … …hold in too great esteem; overrate. —*n.* **2.** an … . [1815–25] —**o′ver•es′ti•ma′tion,** *n.*

…k spōz′), *v.t.*, **-posed, -pos•ing.** **1.** to expose … …lew. **2.** to expose (a photographic film, plate, … —**o′ver•ex•po′sure** (-spō′zhər), *n.*

…k stend′), *v.t.* **1.** to extend or expand beyond … …nable point. **2.** to obligate (oneself) to more … …time or resources for. [1935–40] —**o′ver•ex•…**

…*t.* **1.** to fill too full, so as to cause overflow; … too full. [1200–50]

…*v.t.* to fish (an area) excessively; exhaust the … (a body of water). [1865]

…), *n.* an air flight that passes over a specific …

…′; *n.* ō′vər flō′), *v.i.* **1.** to flow or run over, as … ve the contents flowing over or spilling. **3.** to …

…from one part to another as if flowing from an overfull space: *…population overflowed into the adjoining territory.* **4.** to be sup… …ed with in great measure; *a heart overflowing with gratitude.* —*v.t.* … …to flow over; flood; inundate. **6.** to flow over or beyond (the brim, … …banks, borders, etc.). **7.** to flow over the edge or brim of. **8.** to cause … …overflow. —*n.* **9.** an overflowing. **10.** something that flows or runs … …over. **11.** a portion crowded out of an overfilled place. **12.** an excess … …or superabundance. **13.** an outlet or receptacle for excess liquid. [bef. … …900]

…over•fly (ō′vər flī′), *v.t.*, **-flew, -flown, -fly•ing.** **1.** to fly over (a … …specified area, country, etc.). **2.** to fly farther than or beyond. **3.** to … …fly over or past instead of making a scheduled stop. [1550–60]

…over•glaze (*n., adj.* ō′vər glāz′; *v.* ō′vər glāz′, ō′vər glāz′), *n.*, *v.*, **…glazed, -glaz•ing,** *adj.* —*n.* **1.** a color or glaze applied to an existing … …glaze. —*v.t.* **2.** to cover or decorate with an overglaze. —*adj.* **3.** used … …as an overglaze. **4.** (of decorations) applied over a glaze. [1585–95]

…over•grow (ō′vər grō′, ō′vər grō′), *v.*, **-grew, -grown, -grow•ing.** … …*t.* **1.** to grow over; cover with a growth of something. **2.** to grow … …beyond, grow too large for, or outgrow. —*v.t.* **3.** to grow to excess; … …grow too large. **4.** to become grown over, as with weeds. [1300–50]

…over•growth (ō′vər grōth′), *n.* **1.** a growth overspreading or cover… …ing something. **2.** excessive growth. [1595–1605]

…over•hand (ō′vər hand′), *adj.* **1.** thrown or performed with the … …hand and often part or all of the arm raised over the shoulder; over… …arm. **2.** (in sewing and embroidery) designating one of a row of tiny, … …close-set stitches for binding over two edges of material. —*adv.* **3.** … …with the hand raised above the shoulder: *to pitch overhand.* **4.** with … …the hand over the object. —*n.* **5.** an overhand stroke, throw, or deliv… —*v.t.* **6.** to sew with overhand stitches. Also, **o′ver•hand′ed** (for … …-ed.; 3). [1860–65]

…overhand knot′, *n.* a simple knot of various uses that slips easily. … …Also called **single knot.** [1830–40]

…over•hang (*v.* ō′vər hang′; *n.* ō′vər hang′), *v.*, **-hung, -hang•ing,** *n.* … …*v.t.* **1.** to hang or be suspended over. **2.** to extend, project, or jut … …over. **3.** to impend over or threaten; loom over. —*v.i.* **4.** to hang over; … …project or jut out over something below. —*n.* **5.** something that ex… …tends or juts out over; projection. **6.** the extent of a projection. **7.** an … …excess or surplus, as of securities, currency, or inventory. **8.** a project… …ing upper part of a building, as a roof or balcony. [1590–1600]

…over•haul (*v.* ō′vər hôl′, ō′vər hôl′; *n.* ō′vər hôl′), *v.t.* **1.** to make … …necessary repairs on; restore to working condition. **2.** to examine … …thoroughly and revise or refurbish: *to overhaul the curriculum.* **3.** to … …gain upon, catch up with, or overtake. **4.** *Naut.* a. to slacken (a rope) … …by hauling in the opposite direction to that in which the rope was … …drawn taut. b. to release the blocks of (a tackle). —*n.* **5.** Also, **o′ver•…** …**haul′ing,** a general examination and repair. [1620–30]

…over•head (*adv.* ō′vər hed′; *adj., n.* ō′vər hed′), *adv.* **1.** above … …one's head; aloft; up in the air or sky, esp. near the zenith. **2.** so as to … …be completely submerged or engulfed: *to plunge overhead in water.* … …*adj.* **3.** situated, operating, or passing above, aloft, or over the head. … **4.** of or pertaining to the general costs of running a business. —*n.* **5.** … …the general, fixed costs of running a business, *as* rent, lighting, and … …heating expenses, that cannot be charged to a specific product or part … …of the work operation. **6.** (in racket sports) a stroke in which the ball … …or shuttlecock is hit with a downward motion from above the head; … …smash. **7.** an overhead compartment, shelf, etc. **8.** a ceiling light. **9.** … …Also called **o′verhead projec′tor,** an apparatus that projects images … …above and behind the operator when transparencies are placed horizon… …tally on its surface and lighted from below. **10.** Also called **o′verhead … …projec′tion,** a picture or image thus projected. [1425–75]

…over•hear (ō′vər hēr′), *v.t.*, **-heard, -hear•ing.** to hear (speech or a … …speaker) without the speaker's intention or knowledge. [1540–50]

…over•heat (ō′vər hēt′), *v.t.* **1.** to heat to excess. **2.** to excite or agi… …tate. **3.** to stimulate (the economy) to excess. —*v.i.* **4.** to become … …overheated. [1350–1400]

…over•ijs•sel (ō′vər ī′səl), *n.* a province in the E Netherlands. … …1,009,997. *Cap.:* Zwolle.

…over•in•dulge (ō′vər in dulj′), *v.t., v.i.*, **-dulged, -dulg•ing.** to in… …dulge to excess. [1735–45] —**o′ver•in•dul′gence,** *n.*

…over•is•sue (ō′vər ish′ōō; *esp. Brit.* -is′yōō), *n.* an excessive issue of … …stocks or bonds, as in excess of needs or authorization. [1795–1805]

…over•joy (ō′vər joi′), *v.t.* to cause to feel great joy or delight; elate. … [1350–1400] —**o′ver•joyed′,** *adj.*

…over•kill (ō′vər kil′), *n.* **1.** the capacity to destroy by nuclear weap… …ons more of an enemy than would be necessary for a victory. **2.** an … …instance of such destruction. **3.** an excess of what is suitable.

o•ver•land (ō′vər land′, -lənd), *adv.* **1.** by, over, or across land. … —*adj.* **2.** proceeding, performed, or carried on overland. [1325–75]

O′ver•land Park′ (ō′vər lənd), *n.* a town in E Kansas, near Kansas … City. 106,860.

o•ver•lap (*v.* ō′vər lap′; *n.* ō′vər lap′), *v.*, **-lapped, -lap•ping,** *n.* … —*v.t.* **1.** to extend over and cover a part of. **2.** to coincide in part … with; have in common with. **3.** to cover and extend beyond. —*v.i.* **4.** … to lap over. **5.** to coincide partly. —*n.* **6.** an act or instance of over… …lapping. **7.** the amount or place of overlapping. **8.** an overlapping … part. [1685–95]

o•ver•lay′ (*v.* ō′vər lā′; *n.* ō′vər lā′), *v.*, **-laid, -lay•ing,** *n.* —*v.t.* **1.** to … lay or place (one thing) over or upon another. **2.** to cover, over… …spread, or surmount with something. **3.** to finish with an overlay: … *wood overlaid with gold.* —*n.* **4.** something laid over something else; … covering. **5.** a superimposed decorative layer. **6.** a sheet laid on the … tympan of a printing press to increase or distribute the impression. **7.** … a transparent sheet placed over artwork, a map, or the like for noting … corrections, instructions, additional information, etc. [1250–1300]

o•ver•lay² (ō′vər lā′), *v.* pt. of OVERLIE.

o•ver•leaf (ō′vər lēf′), *adv.* on the other side of the page or sheet.

o•ver•leap (ō′vər lēp′), *v.t.*, **-leaped** or **-leapt, -leap•ing.** **1.** to leap … over or across. **2.** to overreach (oneself). [bef. 900]

o•ver•lie (ō′vər lī′), *v.t.*, **-lay, -lain, -ly•ing.** **1.** to lie over or on, as a … covering or stratum. **2.** to smother by lying upon it. [1125–75]

o•ver•load (*v.* ō′vər lōd′; *n.* ō′vər lōd′), *v.t.* **1.** to overburden. —*n.* **2.** … an excessive load. [1545–55]

o•ver•look (*v.* ō′vər look′; *n.* ō′vər look′), *v.t.* **1.** to fail to notice or … consider. **2.** to disregard indulgently: *to overlook a child's pout.* **3.** to … excuse; pardon. **4.** to look over, as from a higher position. **5.** to rise … above, esp. so as to afford a view over. **6.** to inspect or peruse. **7.** to … look after; supervise. **8.** *Archaic.* to look upon with the evil eye; be… witch. —*n.* **9.** terrain that affords a good view of things below. … [1325–75] —**Syn.** See SLIGHT.

o•ver•lord (ō′vər lôrd′), *n.* **1.** a person who is lord over other lords. … **2.** a person of great influence or power. —*v.t.* **3.** to rule tyrannically. … [1150–1200] —**o′ver•lord′ship,** *n.*

o•ver•ly (ō′vər lē), *adv.* excessively; too. [bef. 1050; ME; OE *oferlīce*]

o•ver•man (ō′vər man *for 1,* ō′vər man′ *for 2*), *n.*, *pl.* **-men** (-man *for 1;* -men′ *for 2*). **1.** a foreman, supervisor, or overseer. **2.** SUPER… …MAN. [1200–1250]

o•ver•mas•ter (ō′vər mas′tər, -mä′stər), *v.t.* to gain mastery over; … dominate; overpower. [1300–50]

o•ver•match (ō′vər mach′), *v.t.* **1.** to be more than a match for; sur… pass; defeat. **2.** to match against a superior opponent or competitor. … [1300–50; ME *overmacchen*]

o•ver•much (ō′vər much′), *adj., n., adv.* too much. [1250–1300]

o•ver•night (*adv.* ō′vər nīt′; *adj., n.* ō′vər nīt′), *adv.* **1.** for or during … the night. **2.** very quickly; suddenly: *New suburbs sprang up over… night.* **3.** on the previous evening. —*adj.* **4.** done, made, occurring, or … continuing during the night: *an overnight stop.* **5.** staying for one … night: *overnight guests.* **6.** intended for delivery on the next day. **7.** … valid for one night: *an overnight pass.* **8.** occurring suddenly or within … a very short time. —*n.* **9.** an overnight stay or trip. [1325–75]

overnight′ bag′, *n.* a travel bag large enough to hold personal arti… cles and clothing for an overnight trip. [1920–25]

o•ver•night•er (ō′vər nī′tər), *n.* **1.** OVERNIGHT (def. 9). **2.** a person … making an overnight stay. **3.** something serving overnight travel, as a … special train or an overnight bag. [1955–60]

o•ver•pass (*n.* ō′vər pas′, -päs′; *v.* ō′vər pas′, -päs′), *n., v.*, **-passed** … or **-past, -pass•ing.** —*n.* **1.** a road, walkway, or bridge providing ac… cess over another route. —*v.t.* **2.** to pass over; traverse. **3.** to exceed; … overstep; transgress. **4.** to surpass. **5.** to ignore; disregard. —*v.i.* **6.** to … pass over or by. [1250–1300]

o•ver•pay (ō′vər pā′), *v.t.*, **-paid, -pay•ing.** **1.** to pay more than (an … amount due). **2.** to pay (a person) in excess. [1595–1605] —**o′ver•…** …**pay′ment** (-pā′mənt), *n.*

o•ver•play (ō′vər plā′), *v.t.* **1.** to exaggerate or overemphasize (one's … role in a play, an emotion, an effect, etc.). **2.** to put too much stress … on the value or importance of. **3.** to hit (a golf ball) past the putting … green. —*Idiom.* **4.** **overplay one's hand,** to overestimate the strength … of one's position. [1640–50]

o•ver•plus (ō′vər plus′), *n.* SURPLUS. [1350–1400]

o•ver•pop•u•late (ō′vər pop′yə lāt′), *v.t.*, **-lat•ed, -lat•ing.** to fill … with too many people, straining available resources and facilities. … [1865]

o•ver•pow•er (ō′vər pou′ər), *v.t.* **1.** to overcome by superior force;

…*adj.*; **-ness,** *n.* **o′ver•crit′i•cal,** *adj.*; **-ly,** *adv.*
o′ver•crit′i•cize′, *v.*, **-cized, -ciz•ing.**

…*t.*, **-cat•ed,** **o′ver•crowd′ed,** *adj.*; **-ly,** *adv.*
o′ver•dec′o•ra′tion, *n.*
o′ver•del′i•cate, *adj.*
o′ver•de•mand′ing, *adj.*
…**-ly,** *adv.* **o′ver•de•pend′ent,** *adj.*
adj. **o′ver•de•ter′mined,** *adj.*
…. **o′ver•dil′i•gence,** *n.*
o′ver•dra•mat′ic, *adj.*
o′ver•ea′ger, *adj.*; **-ly,** *adv.*

o′ver•ed′u•cate′, *v.t.*, **-cat•ed, -cat•ing.**
o′ver•e•lab′o•rate, *adj., v.*
o′ver•em•bel′lish, *v.t.*
o′ver•e•mo′tion•al, *adj.*
o′ver•em′pha•sis, *n.*
o′ver•en•dowed′, *adj.*
o′ver•en•rolled′, *adj.*
o′ver•e•quipped′, *adj.*
o′ver•ex•cit′a•ble, *adj.*; **-bly,** *adv.*
o′ver•ex•cite′, *v.t.*, **-cit•ed, -cit•ing.**
o′ver•ex•ert′, *v.t.*
o′ver•ex•u′ber•ant, *adj.*; **-ly,** *adv.*
o′ver•fa•mil′iar, *adj.*; **-ly,** *adv.*
o′ver•far′, *adv., adj.*
o′ver•fast′, *adj.*
o′ver•feed′, *v.*, **-fed, -feed•ing.**
o′ver•fond′, *adj.*; **-ly,** *adv.*; **-ness,** *n.*
o′ver•for′mal•ize′, *v.*, **-ized, -iz•ing.**
o′ver•ful•fill′, *v.t.*
o′ver•full′, *adj.*; **-ness,** *n.*
o′ver•gen′er•al•i•za′tion, *n.*
o′ver•gen′er•al•ize′, *v.t., v.i.*, **-ized, -iz•ing.**
o′ver•gen′er•ous, *adj.*; **-ly,** *adv.*
o′ver•hast′i•ly, *adv.*
o′ver•hast′y, *adj.*
o′ver•im•ag′i•na•tive, *adj.*
o′ver•im•pres′sion•a•ble, *adj.*
o′ver•in•dus′tri•al•i•za′tion, *n.*
o′ver•in•flate′, *v.t.*, **-flat•ed, -flat•ing.**
o′ver•in′flu•en′tial, *adj.*
o′ver•in•sist′ent, *adj.*; **-ly,** *adv.*
o′ver•in•sure′, *v.t.*, **-sured, -sur•ing.**
o′ver•in′tel•lec′tu•al, *adj.*; **-ly,** *adv.*
o′ver•in•tense′, *adj.*; **-ly,** *adv.*
o′ver•lad′en, *adj.*
o′ver•large′, *adj.*
o′ver•lav′ish, *adj.*
o′ver•lib′er•al, *adj.*; **-ly,** *adv.*
o′ver•lit′er•al, *adj.*
o′ver•long′, *adj., adv.*
o′ver•loud′, *adj.*; **-ness,** *n.*
o′ver•med′i•cate′, *v.t.*, **-cat•ed, -cat•ing.**
o′ver•mod′est•y, *n.*
o′ver•o•pin′ion•at′ed, *adj.*

EXHIBIT 6

US005156986A

United States Patent [19]

Wei et al.

[11] Patent Number: 5,156,986

[45] Date of Patent: Oct. 20, 1992

[54] **POSITIVE CONTROL OF THE SOURCE/DRAIN-GATE OVERLAP IN SELF-ALIGNED TFTS VIA A TOP HAT GATE ELECTRODE CONFIGURATION**

[75] Inventors: **Ching-Yeu Wei; George E. Possin; Robert F. Kwasnick**, all of Schenectady, N.Y.

[73] Assignee: **General Electric Company**, Schenectady, N.Y.

[21] Appl. No.: **667,149**

[22] Filed: **Mar. 11, 1991**

Related U.S. Application Data

[62] Division of Ser. No. 593,423, Oct. 5, 1990, abandoned.

[51] **Int. Cl.**[5] **H01L 21/336**; H01L 21/28

[52] **U.S. Cl.** **437/40**; 437/44; 437/101; 437/909; 357/23.7

[58] **Field of Search** 437/40, 41, 44, 101, 437/245, 246, 228, 909; 156/649, 656, 667; 357/4, 23.7, 2

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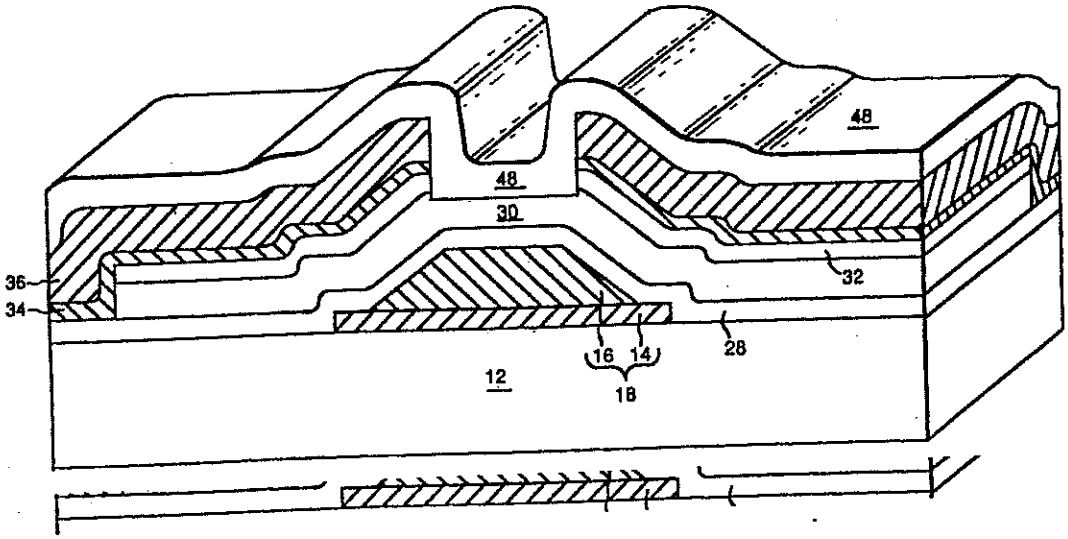
Primary Examiner—Mary Wilczewski

Attorney, Agent, or Firm—Donald S. Ingraham; James C. Davis, Jr.; Marvin Snyder

[57] **ABSTRACT**

Positive control over the length of the overlap between the gate electrode and the source and drain electrodes in a thin film transistor is provided by a gate conductor layer comprising two different conductors having differing etching characteristics. As part of the gate conductor pattern definition process, both gate conductors are etched to expose the underlying material and the upper gate conductor layer is etched back to expose the first gate conductor layer in accordance with the desired overlap between the gate electrode and the source and drain electrodes. Thereafter, the remainder of the device is fabricated with the source and drain electrodes self-aligned with respect to the second gate conductor layer using a planarization and non-selective etch method.

13 Claims, 15 Drawing Sheets



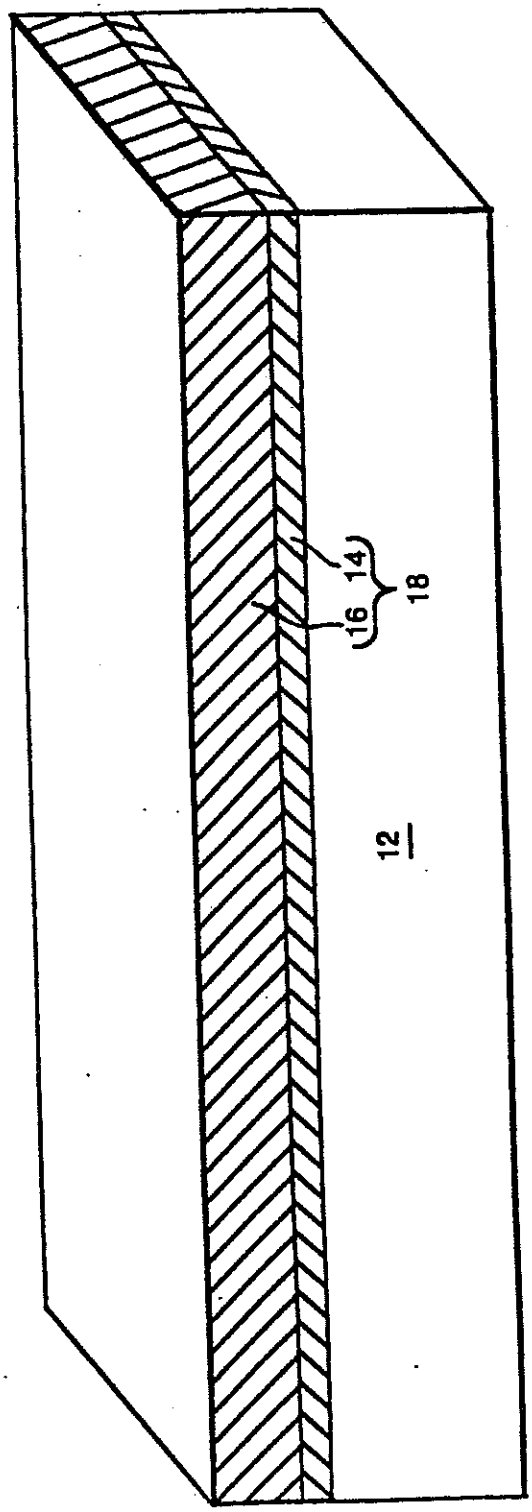


FIG. 1

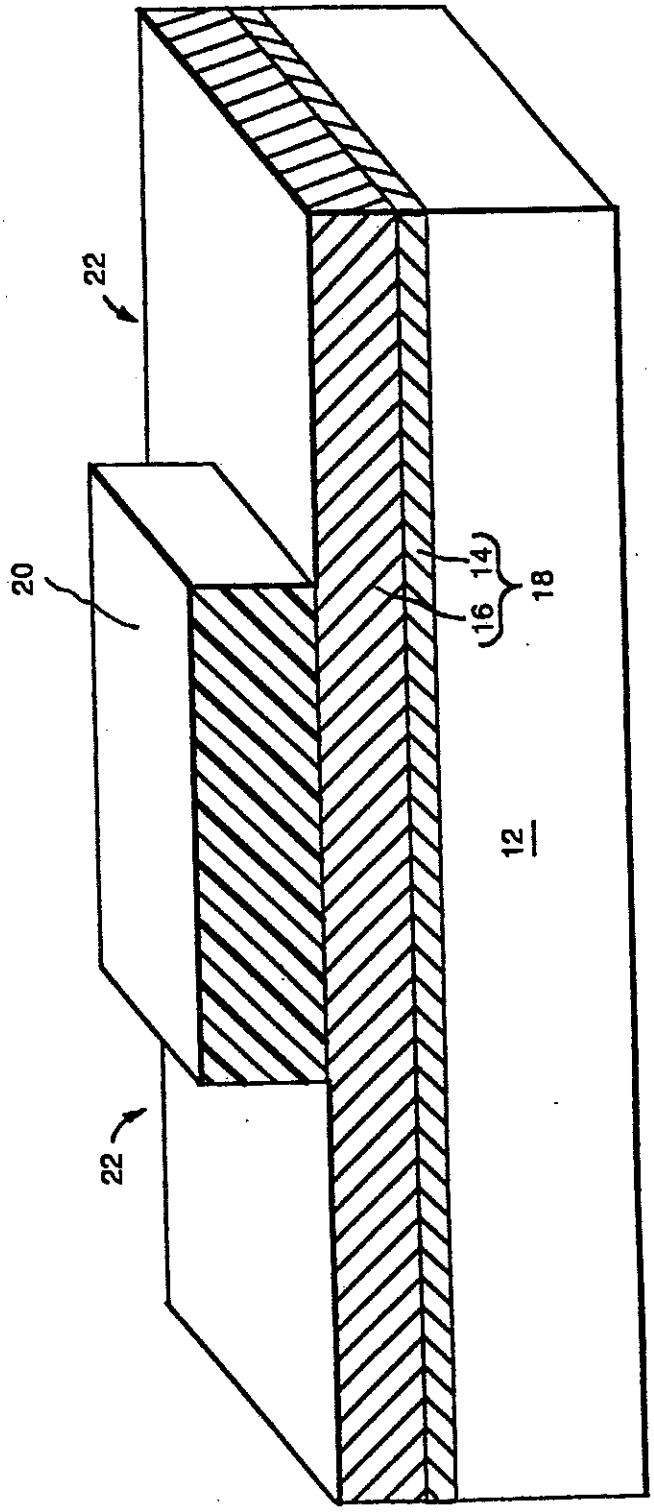


FIG. 2

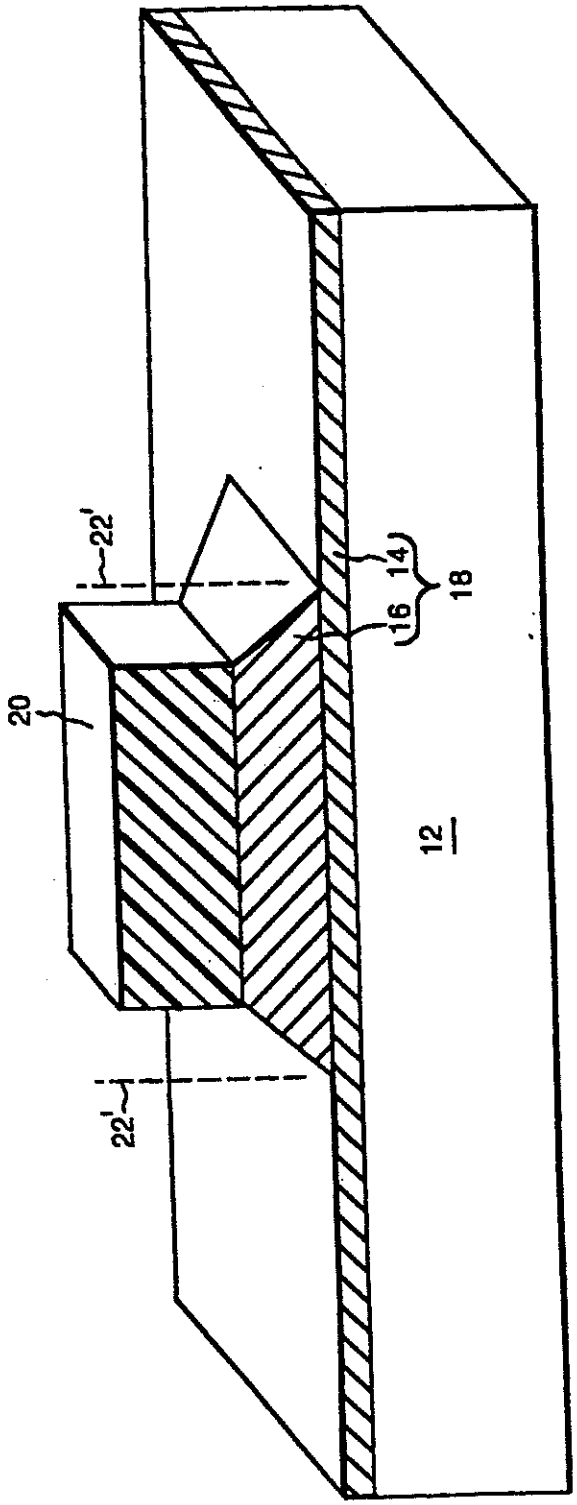


FIG. 3

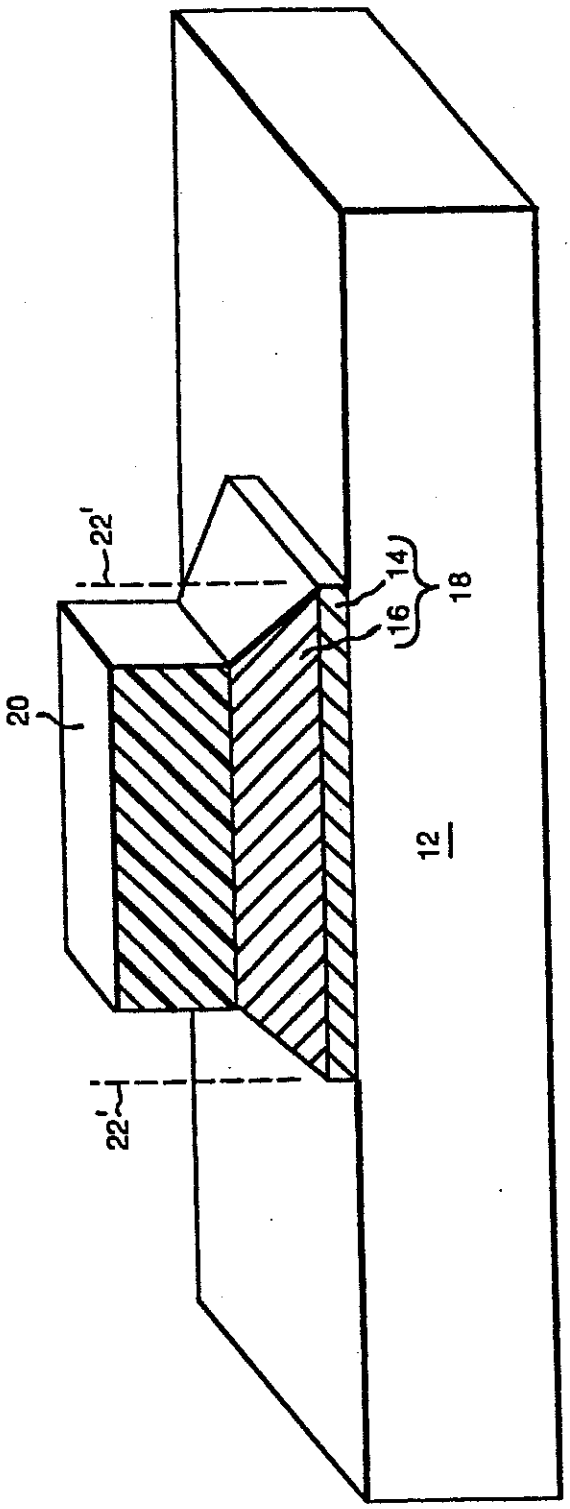


FIG. 4.

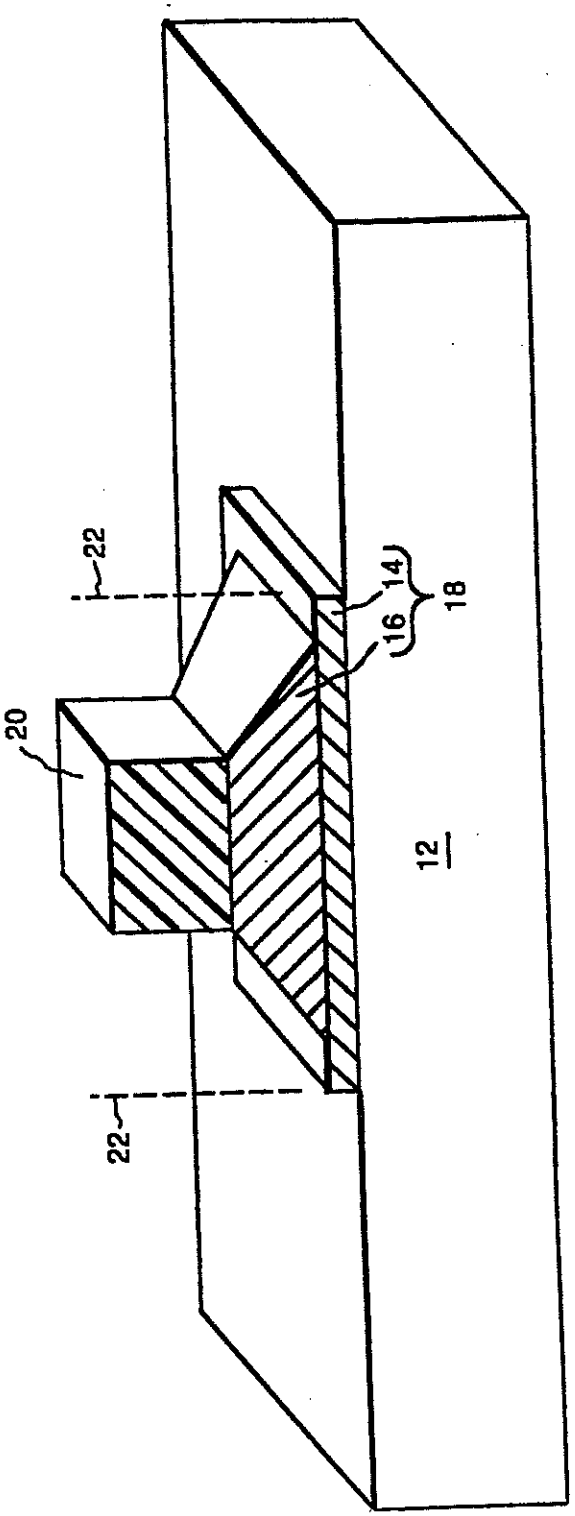


FIG. 5

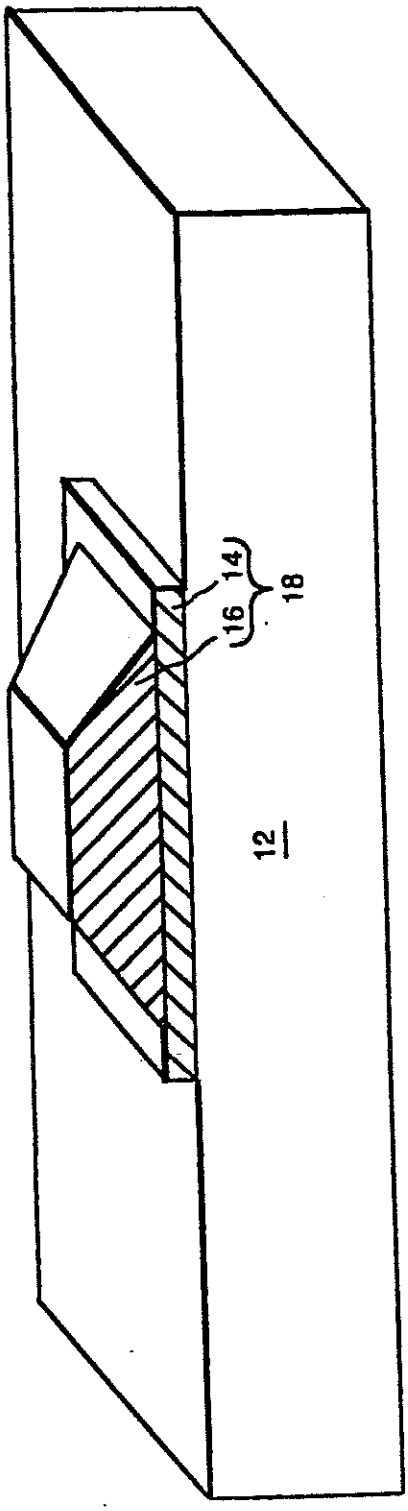


FIG. 6

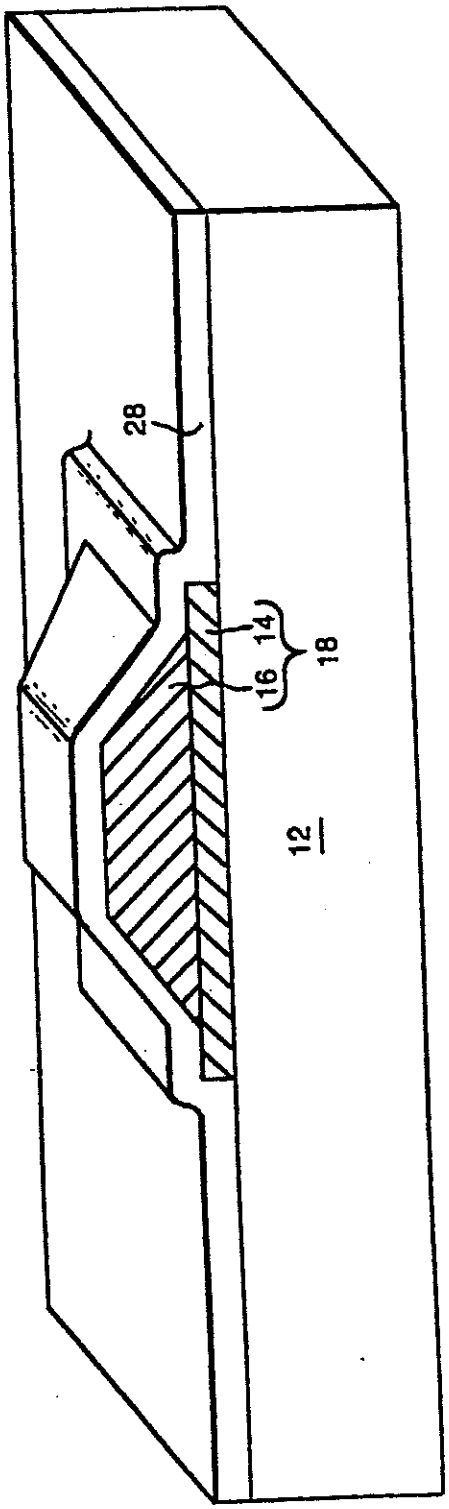


FIG. 7

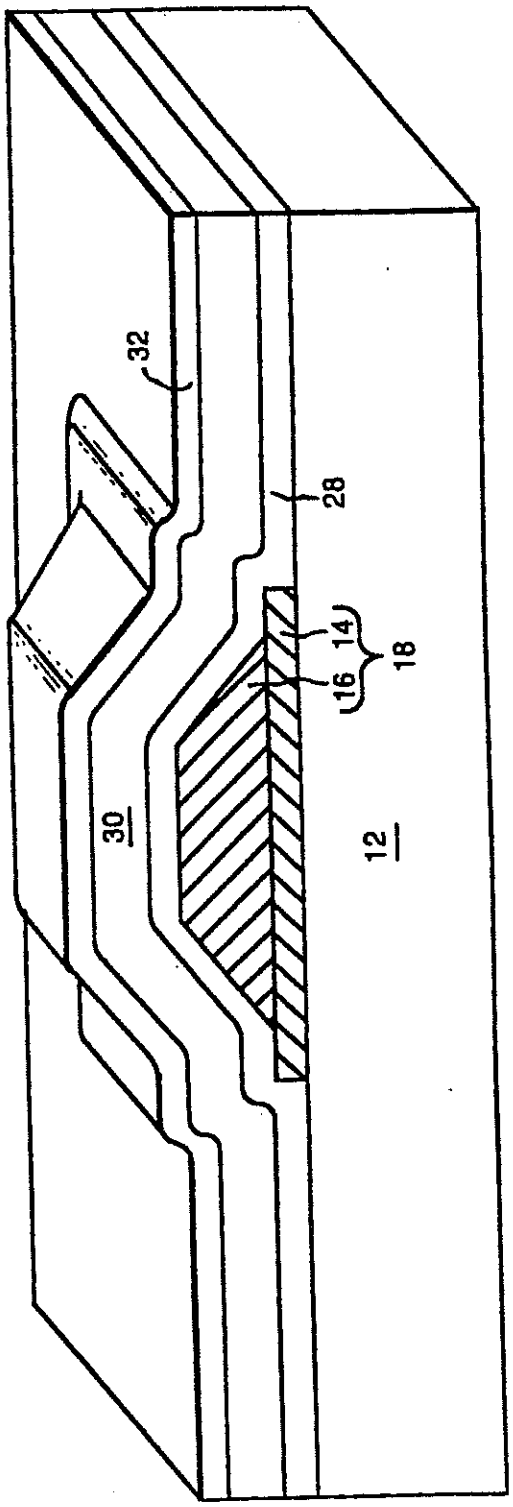


FIG. 8

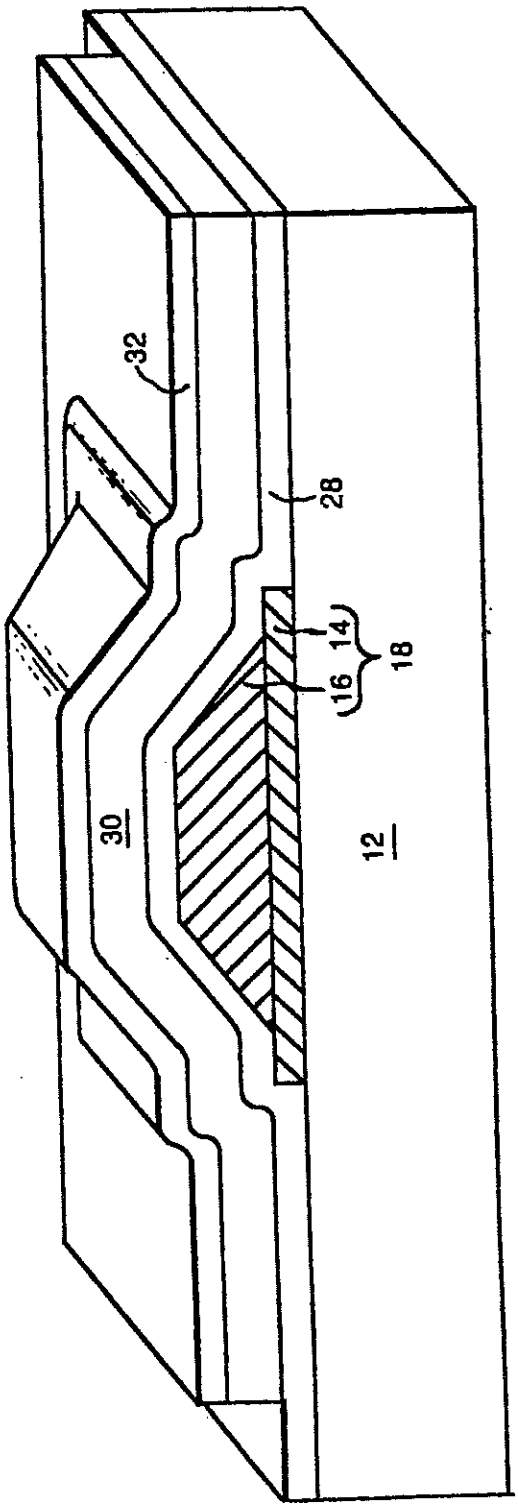


FIG. 9

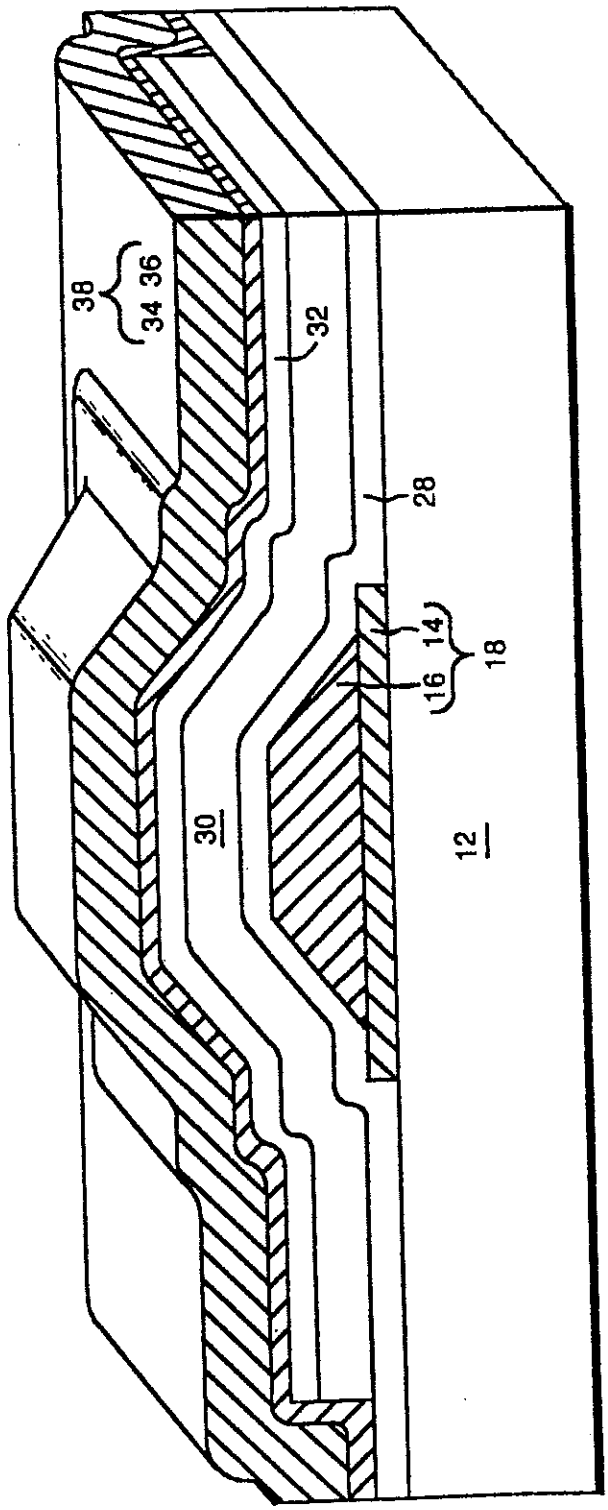


FIG. 10

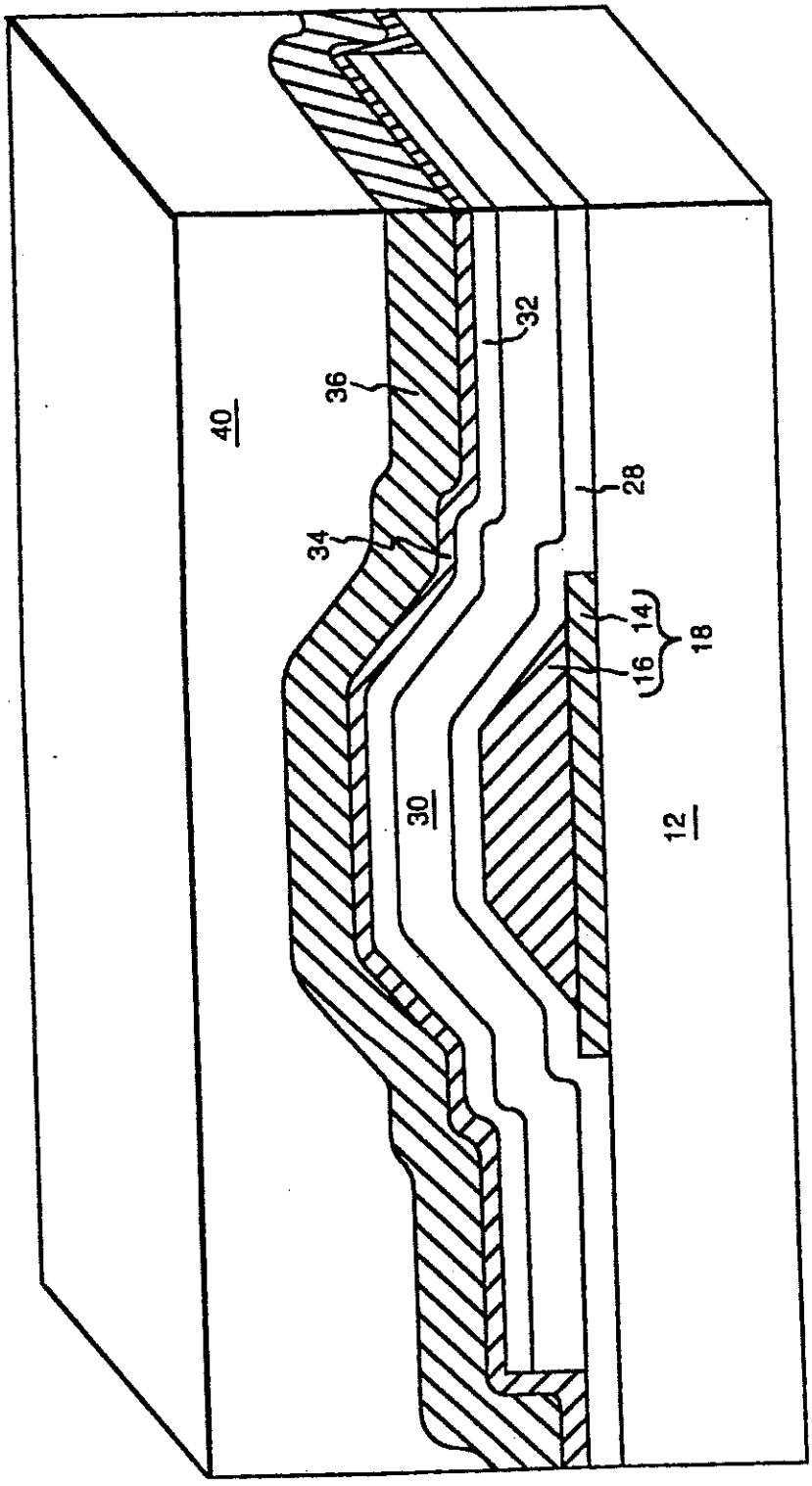
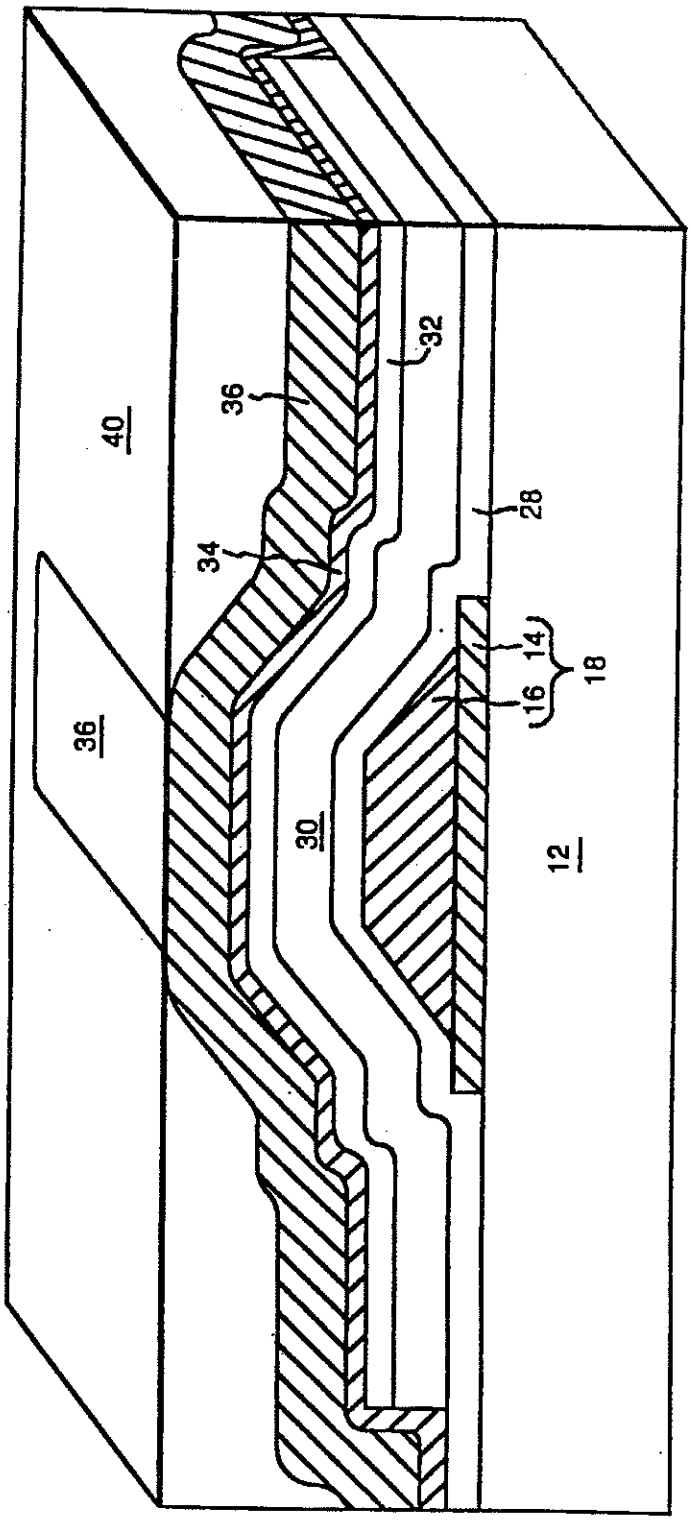


FIG. 11

FIG. 12



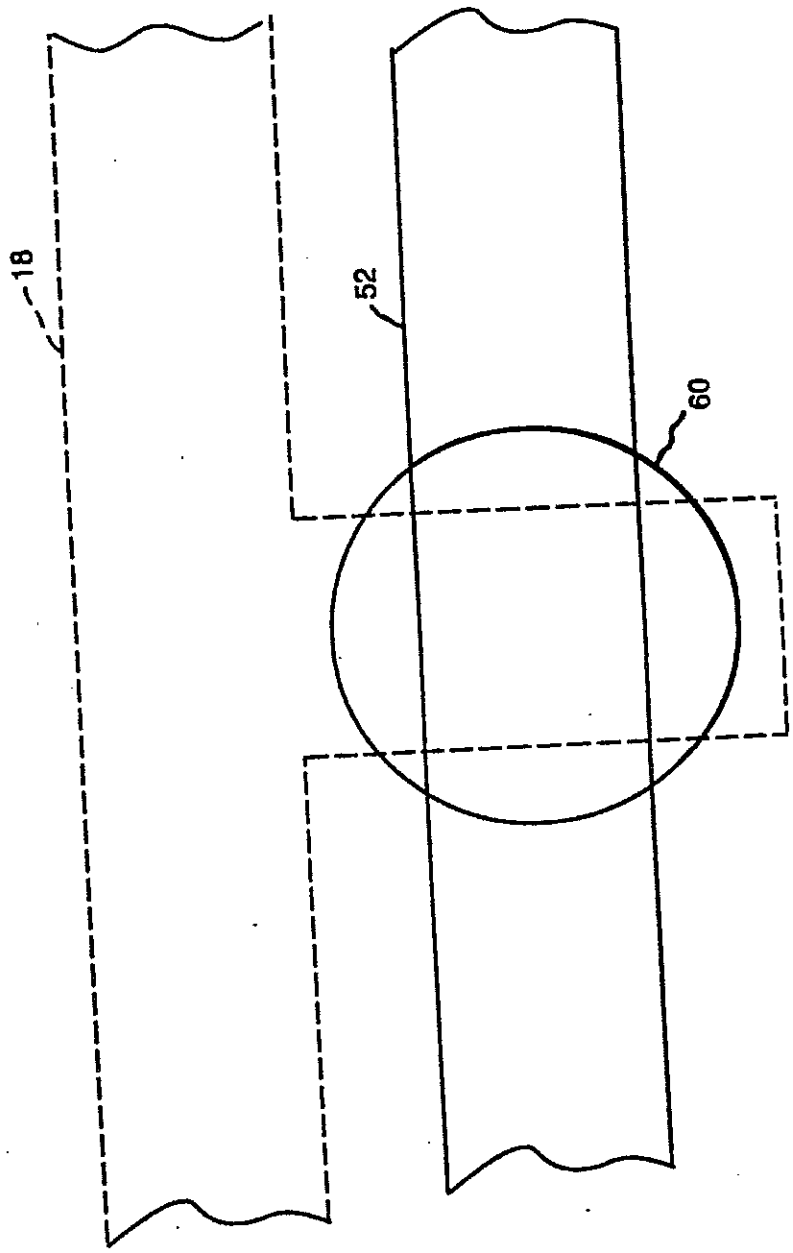


FIG. 13

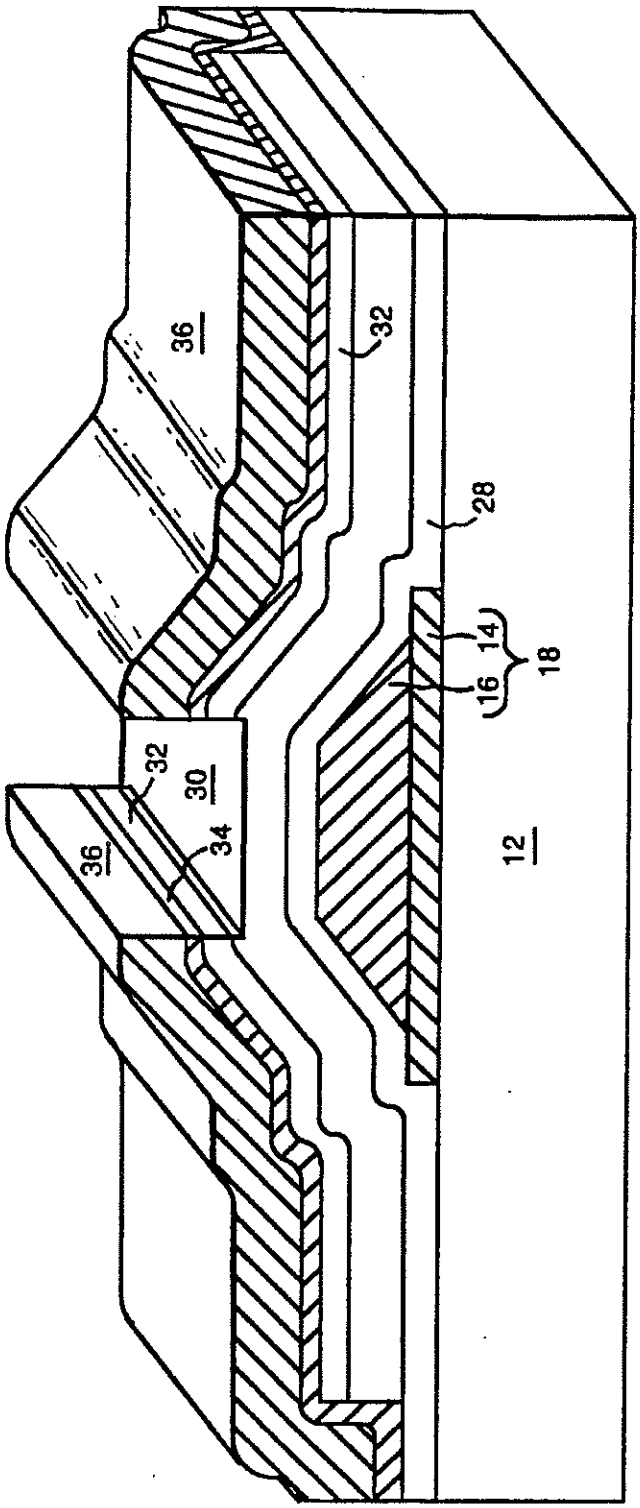


FIG. 14

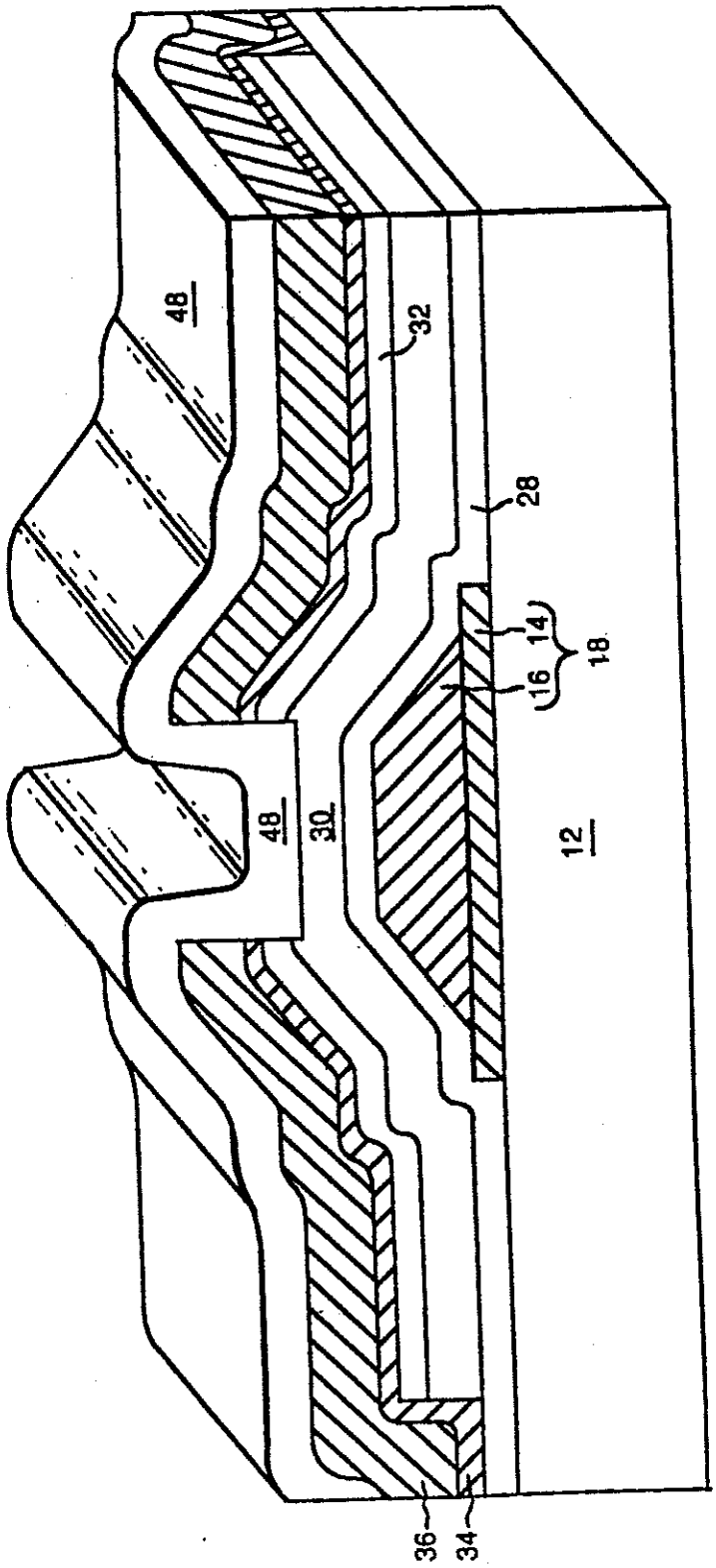


FIG. 15

POSITIVE CONTROL OF THE SOURCE/DRAIN-GATE OVERLAP IN SELF-ALIGNED TFTS VIA A TOP HAT GATE ELECTRODE CONFIGURATION

This application is a division of application Ser. No. 07/593,423, filed Oct. 5, 1990, now abandoned.

RELATED APPLICATIONS

The present application is related to application Ser. No. 07/593,419, filed Oct. 5, 1990, entitled, "Thin Film Transistor Structure With Improved Source/Drain Contacts", by R. F Kwasnick, et al.; application Ser. No. 07/593,425, filed Oct. 5, 1990, entitled "Device Self-Alignment by Propagation of a Reference Structure's Topography", by C-Y Wei, et al.; application Ser. No. 07/593,421, filed Oct. 5, 1990, entitled, "Thin Film Transistor Having an Improved Gate Structure and Gate Coverage by the Gate Dielectric" by R. F. Kwasnick, et al.; application Ser. No. 07/510,767, filed Apr. 17, 1990, entitled "Method for Photolithographically Forming a Self-Aligned Mask Using Back Side Exposure and a Non-Specular Reflecting Layer", by G. E. Possin, et al.; and application Ser. No. 07/499,733, filed Mar. 21, 1990, entitled "Method for Fabricating a Self-Aligned Thin-Film Transistor Utilizing Planarization and Back-Side Photoresist Exposure", by G. E. Possin, et al., now U.S. Pat. No. 5,010,027, each of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to the field of fabrication techniques for thin film transistors, and more particularly to techniques for self-aligned fabrication of thin film transistors.

Background Information

Thin film transistors (TFTs) are employed in liquid crystal displays and imagers to control or sense the state of each pixel of the display or image. At present, such thin film transistors are typically fabricated from amorphous silicon. In such display or sensor systems, system operating characteristics are optimized by making each cell or pixel have substantially identical operating characteristics. These operating characteristics include switching speed, capacitive loading of drive and sense lines, the gain of transistors and so forth.

One of the processing problems which causes variation in the characteristics of different cells within such structures is the inability to accurately align the position of a mask which defines the source and drain electrodes of thin film transistors in a manner which ensures that the source/drain electrodes are accurately aligned with respect to the gate electrodes. Misalignment results in an increase in the overlap between the gate electrode and either the source electrode or the drain electrode with a corresponding decrease in the overlap between the gate and the other of them. Since the capacitances between the gate electrode and the source or drain electrodes are direct functions of the overlap between them, such a change in overlap produces a change in device's capacitances and consequently, switching speed and loading of other circuits. The possibility of misalignment requires that the size of the gate metal be increased to ensure that all devices have acceptable overlap between the gate and the source and drain. This

increases the device size and hence the total capacitance per device. The device capacitance is important because it controls the charging time of the gate electrodes, the capacitive coupling between the gate and the source and drain nodes, and the noise introduced by the defects in the amorphous silicon or at the amorphous silicon/-dielectric interface. Consequently, there is a desire to provide self-alignment between the source and drain electrodes and the gate electrode in order to maintain a fixed, predictable overlap between the gate electrode and each of the source and drain electrodes across an entire wafer.

A variety of self-alignment techniques have been proposed or developed. The above-identified related applications Ser. Nos. 07/499,733 and 07/510,767 each disclose techniques for obtaining self-alignment between the gate electrode and the source and drain electrodes through the use of through-the-substrate exposure of photoresist. Such processes result in specific gate-to-source and gate-to-drain overlaps which are peculiar to those techniques and the particular manner in which they are carried out. Those overlaps may be smaller or larger than optimum. Such a through-the-substrate exposure technique is not suitable where the semiconductor itself or another device layer would absorb the light needed to expose the photoresist. Consequently, there is a need for other self-alignment techniques for thin film transistors.

Related application Ser. No. 07/593,425 solves these problems by employing mechanical propagation of topographical features of a lower, reference layer, upward through subsequently deposited layers of the structure, including a support layer. A subordinate layer (source/drain metallization) is deposited on the support layer and may be either conformal or not conformal. If necessary, a planarization layer is formed over the subordinate layer to provide a planar upper surface for the structure. Material is then removed from the upper surface in a non-selective, uniform manner until the source/drain metallization becomes exposed in an aperture which is thereby created in the planarization layer in alignment with the underlying reference layer pattern. The exposed portion of the subordinate layer is then selectively etched to expose the support layer. Alternatively, the planarization etch could be continued until the support layer was exposed, but that would result in thinner source and drain electrodes. Other portions of the subordinate layer are then patterned, if necessary and the fabrication of the device completed. The result is a device in which the overlap of the subordinate layer over the reference pattern in the vicinity of the aperture in the subordinate layer is self-aligned with respect to the reference layer pattern.

The technique of application Ser. No. 07/593,425 can provide a very short overlap between the gate electrode and the source and drain electrodes. In particular, an overlap of less than 0.5 μm is achievable. Such a small overlap is desirable from the point of view of minimizing overlap capacitance and capacitance induced noise. Unfortunately, it is found experimentally that there is a minimum overlap between the gate and the source and drain electrodes below which the saturation drain current of a TFT degrades significantly. While the minimum length of this overlap for good device operating characteristics may vary with different semiconductor materials and other variations in the device structure, it would be desirable to have a technique for positively

controlling the amount of overlap between the gate electrode and the source and drain electrodes in a self-aligned TFT structure.

OBJECTS OF THE INVENTION

Accordingly, a primary object of the present invention is to provide a technique for positively controlling the length of the overlap between the gate electrode and the source and drain electrodes in a self-aligned thin film transistor.

Another object of the present invention is to increase the versatility of the self-alignment technique disclosed in related application Ser. No. 07/593,425.

Another object of the present invention is to provide a self-alignment method which is applicable to opaque substrates.

SUMMARY OF THE INVENTION

The above and other objects which will become apparent from the specification as a whole, including the drawings, are accomplished in accordance with the present invention by fabricating the gate electrode as two separate layers of different conductors; patterning the entire gate electrode to the desired gate electrode pattern and subsequently etching the second layer of the gate electrode conductor back from the edges of the first level gate electrode conductor in a self-aligned manner whereby positive control of the degree of setback of the tapered edge of the upper layer (thick) gate conductor material from the lower layer (thin) conductor material is provided while retaining self-alignment. In this manner, a self-aligned process which relies on propagation of the topography of the gate electrode through subsequently deposited layers of the structure provides gate-to-source and gate-to-drain electrode overlaps which are controlled by the setback of the second gate conductor layer with respect to the first gate conductor layer in addition to the setback produced by the slope of the tapered second gate conductor layer.

In accordance with one embodiment of the invention, the first and second gate conductor layers are sequentially deposited on a substrate in the same vacuum pumpdown, the gate conductor is photomasked and etched to expose the substrate in the areas where the gate conductor is not desired. Thereafter, the second gate conductor layer is etched back from the edge of the first conductor layer using the same gate mask and an etchant to which the first gate conductor layer is substantially immune and with a technique which tapers the second gate conductor layer to provide lateral edges on that layer which are suitable for the deposition of conformal layers thereover. Thereafter, substantially conformal gate dielectric and semiconductor layers are deposited on the structure followed by patterning of the semiconductor layers and then deposition of source/drain metallization which may be conformal or nonconformal. Where the source/drain metallization does not exhibit a planar upper surface, a planarization layer is deposited on top of the source/drain metallization to provide a planar upper surface for the device structure. The device structure is then etched in a non-selective manner until the source/drain metallization is exposed in alignment with the raised (thick) portion of the gate electrode pattern. The exposed portion of the source/drain metallization is then selectively etched to expose the n^+ amorphous silicon which is then removed. Thereafter, back channel passivation may be provided on the upper surface of the structure to minimize the effect of external conditions on the operating characteristics of the device.

The resulting semiconductor device has a setback or top hat gate conductor configuration in which the effective electrical gate width is that of the thin, lower, wider gate conductor layer while the configuration of the thicker, upper, narrower gate conductor layer controls the self-alignment of the source and drain electrodes with respect to the gate electrode and thus the overlap between the source and drain electrodes and the gate electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of practice, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

FIGS. **1–14** illnstrate successive stages in the fabrication of a thin film transistor in accordance with the present invention;

FIG. **1** is a perspective, partially cross section view of a substrate having an unpatterned reference layer disposed thereon;

FIG. **2** is a perspective, partially cross section view of the FIG. **1** structure having a patterned layer of photoresist disposed thereon;

FIG. **3** is a perspective, partially cross section view of the FIG. **2** structure following etching of an upper gate conductor layer;

FIG. **4** is a perspective, partially cross section view of the FIG. **3** structure following etching of a lower gate conductor layer;

FIG. **5** is a perspective, partially cross section view the structure following etch back of the upper layer of the gate conductor from the edge of the lower gate conductor;

FIG. **6** is a perspective, partially cross-section view of the FIG. **5** structure following stripping of the retained photoresist;

FIG. **7** is a perspective, partially cross-section view of the FIG. **6** structure following the deposition of a gate insulator thereover;

FIG. **8** is a perspective, partially cross-section view of the structure following the deposition of two layers of semiconductor material;

FIG. **9** is a perspective, partially cross-section view of the FIG. **8** structure after patterning of the layers of semiconductor material;

FIG. **10** is a perspective, partially cross-section view of the structure following the deposition of two layers of source/drain metallization;

FIG. **11** is a perspective, partially cross-section view of the structure following completion of the structure through the formation of a substantially planar surface;

FIG. **12** is a plan view of a portion of the structure;

FIG. **13** is a perspective, partially cross-section view of the structure following uniform removal of enough material from the structure to expose the support layer within an aperture in the subordinate layer;

FIG. **14** is a perspective, partially cross-section view of the FIG. **13** structure following etching of the support layer in the self-aligned openings in the subordinate layer; and

FIG. 15 is a perspective, partially cross-section view of the structure following formation of a passivation layer over the structure.

DETAILED DESCRIPTION

In accordance with one embodiment of the present invention, an amorphous silicon thin film (TFT) field effect transistor (FET) may be fabricated. Various stages in the fabrication of such a device in accordance with the present invention are illustrated in FIGS. 1–14.

In FIG. 1, a substrate 12 has a uniform reference layer 18 disposed thereon. Reference layer 18 comprises first and second sublayers 14 and 16. For fabrication of a thin film transistor, the layer 18 constitutes the gate conductor while the substrate 12 constitutes a larger structure on which the transistor is to be disposed. In many applications such as liquid crystal displays and imagers, it is desirable that the substrate 12 be transparent, however, transparency of the substrate is unimportant to the present process and thus, is a matter of design choice in accordance with the intended use of the thin film transistor to be fabricated. Typical transparent substrate materials are glass, quartz and appropriate plastics.

The gate conductor sublayers 14 and 16 are deposited on the substrate in sequence by any appropriate technique such as sputtering, chemical vapor deposition, thermal evaporation and so forth. This gate conductor is comprised of two layers of different metals such as a first layer of titanium disposed in contact with the substrate with a layer of molybdenum or aluminum (referred to as Mo/Ti and Al/Ti metallization, respectively) disposed thereover or a layer of chromium disposed on a substrate with a layer of molybdenum disposed thereover (Mo/Cr metallization). As a further alternative, the first sublayer of the gate conductor may be a transparent conductor material such as indium tin oxide or other transparent conductors. We prefer to use Mo/Cr.

The gate electrode is typically deposited to a thickness of 1,000 Å to 10,000 Å, depending on the sheet resistivity required for the gate electrode structure and the vertical height of the top hat gate required to achieve good self-alignment. With a Mo/Cr gate conductor, the Cr is preferably 100 to 500 Å thick and the Mo is preferably 1000 to 10,000 Å thick.

The FIG. 1 structure is then photomasked to provide a mask pattern corresponding to the desired gate conductor configuration as shown in FIG. 2. The upper surface of the second conductor 16 is exposed in the window 22 where the photoresist 20 has not been retained. Next, the structure is dry etched preferably using reactive ion etching to pattern the upper conductor layer 16 in accordance with the retained photoresist pattern. To do this, the wafer is mounted in a reactive ion etching apparatus which is then purged and evacuated in accordance with normal reactive ion etching procedures. A source gas flow preferably of 37.5 sccm (standard cubic centimeters per minute) of sulphur hexafluoride (SF_6), 6.5 sccm of Cl_2 and 16 sccm of O_2 is established, introduced into the etching chamber at a pressure of 65 mtorr and reactive ion etching potentials are applied to etch the molybdenum in the windows 22. This etching is preferably carried out until all the molybdenum is removed in center of the windows and is allowed to proceed for 40 seconds more of overetching to ensure that all of the molybdenum is removed from within the originally defined windows 22. This molybdenum etching step is preferably carried out at a power of 200 watts.

Following this etching step, the structure appears as illustrated in FIG. 3. It will be noted, that the second conductor (molybdenum) has been removed from the structure everywhere outside the region which was initially protected by the retained portion of the photoresist 20. The original edges of the retained photoresist are indicated by the dash lines marked 22', but the photoresist has been etched back from that original edge as the etching of the molybdenum has proceeded. This results in the substantially 45° slope to the side walls of the molybdenum as illustrated in FIG. 3.

A tapered gate electrode of this type may be provided in a variety of other ways well known in the art including reliance on the erosion of the photoresist during etching of the gate conductor where reactive ion etching (RIE) is employed or an isotropic wet etch may be employed which undercuts the resist during etching of the unprotected portion of the gate conductor.

Such a slope is provided in RIE, in part because when the photoresist is baked after patterning to toughen it prior to RIE etching, the photoresist slumps with the result that its thickness tapers from small or zero at the edge of a photoresist region upward to the central thickness of the photoresist over a finite distance. During reactive ion etching, the photoresist erodes as the gate conductor is etched with the result that a taper is produced on the retained portion of the gate conductor.

Next, the etching gas is preferably changed to 70 sccm of Cl_2 and 30 sccm of O_2 at a pressure of 100 mtorr to remove the exposed chromium. This etch is preferably continued until all the exposed chromium appears to have been removed and is then continued for an additional 60 seconds to ensure complete removal of the exposed chromium. The degree of overetching which should be employed depends on the substrate composition and the relative etch rates of the first conductor 14 and the substrate in the etching composition employed. This etching step is preferably carried out at a power of 300 watts. Following this step, the structure appears as illustrated in FIG. 4.

Next, the molybdenum upper layer of the gate conductor is etched back to expose a desired width of the first gate conductor layer. This may be done with the RIE using the same source gases as for the initial etching of the molybdenum, provided that that etchant does not excessively etch the now exposed portion of the substrate where the chromium has been removed. Following this step, the structure appears as illustrated in FIG. 5.

The retained photoresist is then removed to leave the structure illustrated in FIG. 6.

Next, a gate dielectric layer 28 is deposited over the entire structure preferably by chemical vapor deposition or some other process which is known to produce a high integrity dielectric. This gate dielectric is preferably be silicon nitride but may be silicon dioxide or other dielectrics and is about 1,000 to 4000 Å thick. The chromium gate conductor layer 14 is sufficiently thin (10 to 1000 Å) and the sidewall of the molybdenum gate conductor layer 16 is sufficiently vertically inwardly tapered or sloped that a high integrity conformal dielectric layer results.

This deposition of gate dielectric on the upper surface of the structure is done in a conformal manner whereby the raised configuration of the patterned gate electrode extends to the upper surface of that gate dielectric layer,

that is, the surface topography is essentially unchanged as shown in FIG. 7.

Thereafter, in the fabrication of a typical silicon thin film transistor, a layer 30 of intrinsic amorphous silicon is deposited on the gate dielectric layer in a conformal manner. This intrinsic amorphous silicon layer typically has a thickness on the order of 2,000 Å. A thinner layer 32 (about 500 Å) of doped (typically phosphorous doped, that is n+) amorphous silicon is then deposited on the intrinsic amorphous silicon in a conformal manner to provide the structure illustrated in FIG. 8.

The dielectric layer, the intrinsic amorphous silicon and the doped amorphous silicon may all be deposited in the same deposition chamber without breaking the vacuum. Where that is done, we prefer to stop the plasma discharge in the deposition chamber after the completion of the deposition of a particular layer until after the proper gas composition for the deposition the next layer has been established. We then re-establish the plasma discharge to deposit that new layer. Alternatively, the two silicon depositions may be done in different chambers.

At this stage, the silicon layers may be patterned photolithographically to restrict them to the part of the structure where the silicon is needed, as shown in FIG. 9.

Thereafter, the source/drain metallization is deposited over the structure in a conformal manner. In accordance with application Ser. No. 07/593,419, entitled, "Thin Film Transistor Structure With Improved Source/Drain Contacts", this source/drain metallization is preferably a two layer molybdenum on chromium (Mo/Cr) metallization in which the Cr is 100 to 1000 Å thick and the molybdenum is 1000 to 10,000 Å thick, as shown in FIG. 10. Alternatively, this metallization may be a single metal such as molybdenum, chromium or tungsten. Following this step, the structure appears as illustrated in FIG. 10.

A planarization layer 40 (which may be photoresist) is then formed over the entire structure to provide a substantially planar upper surface of the structure as shown in FIG. 11.

In this manner, the topology of the patterned gate conductor is propagated upward through the various layers, at least through the support layer (the n+ doped amorphous silicon in this example) on which the source/drain metallization is disposed. That propagation of topography could be terminated by the source/drain metallization itself, but is at this time preferably terminated by a separate planarization layer because common metallization deposition processes are substantially conformal in nature and making the source/drain metallization conformal enables the final source and drain electrodes to be thicker.

The entire structure is then etched back in a non-selective manner by a planarization reactive ion etch. This planarization etch is preferably stopped once the molybdenum over the gate electrode has been exposed. That exposed molybdenum is then selectively etched with the remaining portion of the planarization layer serving as the etching mask to restrict that etching to the molybdenum which is over the gate electrode. This is followed by etching the now exposed chromium. As illustrated in FIG. 12, a self-aligned overlap between the source and drain electrodes and the gate electrode is produced. Alternatively, the planarization etch may be continued until the chromium layer of the source/drain metallization has been exposed. That exposed chromium 34 is then selectively etched to expose the doped silicon 32. As a still further alternative, the planarization etch can be continued until the doped silicon becomes exposed.

At this stage, the exposed doped silicon is removed by etching to leave only intrinsic silicon between the source and drain electrodes. This normally involves the removal of some, but not all of the intrinsic amorphous silicon in order to ensure that all of the doped amorphous silicon has been removed.

A key consideration is that the source/drain gap in the circle 60 in the top down view in FIG. 13 is disposed in proper alignment with the underlying gate electrode 18. Since the source/drain gap is defined by the self-aligned planarization method just described, control of the size of the source/drain gap and its location is independent of the alignment of the etching mask 52 which controls the pattern and location of the other portions of the boundary of the retained source/drain metallization.

If the silicon was not patterned previously it is usually necessary to remove excess silicon exposed after the removal of the source/drain metal. This etch is done with the source/drain mask still in place in order to protect the exposed silicon in the channel region.

The source and drain metallization is then patterned to provide the various desired segments of the source and drain metallization which connect to various devices and interconnect devices in a manner which is appropriate to the structure being fabricated. The etching of the pattern of the source/drain metallization may preferably be done in two stages using RIE with the appropriate source gases discussed above or it may be done by wet etching or other means. This yields the structure illustrated in FIG. 14.

Thereafter, a passivation layer 48 may be deposited on the upper surface of the structure as shown in FIG. 15. This passivation layer is known as a back channel passivation layer since its purpose is to passivate the back or the away-from-the-gate-metallization surface of the silicon to maximize the stability of the device characteristics of this thin film transistor. This passivation layer is typically about 2,000 Å thick and may be silicon dioxide, silicon nitride or other insulators such as polyimide.

Typically, the illustrated thin film transistor is only one of many such thin film transistors which are simultaneously fabricated on the same substrate.

While the semiconductor material in the just described embodiment is amorphous silicon, since that is the material presently in typical use for thin film transistors, it should be understood that this process is equally applicable to the use of other semiconductor materials or other forms of silicon. Further, while the gate dielectric layer has been described as being silicon nitride, it will be understood that more than one sublayer may be present in the gate dielectric layer and various sublayers may have different compositions and a single layer dielectric may be SiO_2 or other dielectric materials.

Other semiconductor materials which are presently used in an amorphous condition are germanium and cadmium selenide. This process technique is applicable to those amorphous silicon semiconductor materials and any others as well as being applicable to polycrystalline or even monocrystalline semiconductor materials where the underlying support structure supports the formation of such semiconductor layers.

It will be recognized that the distance by which the upper gate layer **16** is setback from the edge of the lower gate layer **14** is controlled by the rate at which the upper gate layer etches back and the length of time for which that etch back is allowed to proceed. By appropriate control of the etch rate and time this setback can be varied over a substantial range, from a fraction of a micron to several microns or more as may be considered desirable in a particular device.

This provides the ability to controllably increase the degree of overlap between the gate electrode and the source and drain electrodes of self-aligned device produced in accordance with application Ser. No. 07/593,425, "Device Self-Alignment by Propagation of a Reference Structure's Topography". This technique is also applicable to the methods disclosed in related applications Ser. Nos. application Ser. No. 07/510,767, entitled, "Method for Photolithographically Forming a Self-Aligned Mask Using Back Side Exposure and a Non-Specular Reflecting Layer" and application Ser. No. 07/499,733, entitled, "Method for Fabricating a Self-Aligned Thin-Film Transistor Utilizing Planarization and Back-Side Photoresist Exposure", provided that the first gate metallization layer is made of a material which is transparent or sufficiently transmissive of the actinic light employed to expose the photoresist that **50** the photoresist can be exposed through the lower, thin, gate conductor and shadowed by the thick gate conductor in their self-aligned processes which expose the photoresist by directing the exposing radiation through the substrate as a means of establishing the channel region gap between the source and drain electrodes in a self-aligned manner. Transmission of the exposing (UV) radiation through the first, thin gate conductor layer may be provided by use of a conductor layer which is transparent to that light frequency or alternatively, by use of gate metallization material which is opaque to that light frequency, but whose thickness is kept below about 100 Å whereby a substantial portion of the actinic radiation incident thereon passes therethrough.

In this alternative process, the gate metallization pattern is fabricated in the same manner as described above and the device fabrication carried out in the manner described above through the deposition of the layer of intrinsic amorphous silicon. Next, a layer of dielectric material is deposited on that amorphous silicon layer. Then a positive photoresist layer is disposed on that layer of dielectric material, exposed to actinic radiation through the substrate and the underlying layers of the device being fabricated and developed. This leaves a plug of photoresist in alignment with the thick, upper conductor of the gate metallization. This plug is then used as a mask for the removal of the dielectric layer where it is not protected by the photoresist. This leaves a plug of the dielectric material disposed on the intrinsic amorphous silicon in alignment with the thick, upper gate conductor material. Since this plug is set back from the edge of the gate electrode (the outer edge of the lower thin gate conductor) and will eventually space the source and drain electrodes apart, the overlap between the source and drain electrodes and the gate is substantially greater than it is in those basic processes for the same photoresist exposure and development conditions. Consequently, there will in general be no need to overexpose or overdevelop the photoresist in order to increase that overlap between the gate electrode and the source and drain electrodes.

Next, a layer of n^+ doped amorphous silicon is deposited over the dielectric plug and the exposed portions of the intrinsic amorphous silicon. The source/drain metallization is then deposited, a planarization layer such as photoresist is formed over the upper surface of the structure and that upper surface of the structure is uniformly etched in a non-selective manner until the source/drain metallization is exposed over the dielectric plug because of its greater height there. This exposed portion of the source/drain metallization may then be selectively etched to expose the n^+ doped amorphous silicon which is disposed on the dielectric plug. The now exposed portion of the n^+ amorphous silicon is then removed to expose the top of the dielectric plug to isolate the source and drain electrodes from each other in this region. The source/drain metallization layer is then further patterned to remove at least those portions which connect the source and drain electrodes to each other outside this portion of the structure. Alternatively, that patterning of the source/drain metallization may be done before deposition of the planarization layer. Any other steps necessary to the fabrication of the device are then carried out.

There are a number of other variations possible. The silicon could be left unpatterned. This results in intrinsic amorphous silicon and n^+ amorphous silicon being left under the source/drain metallization in all places. For applications such as imagers this is acceptable. Just the intrinsic amorphous silicon could be patterned before the n^+ amorphous silicon deposition and then the source/drain metallization deposited. This would result in n^+ under the source/drain metallization in all places. This could be acceptable even for displays where the contact to the transparent electrode would then be metal/n^+/transparent electrode.

While the invention has been described in detail herein in accord with certain preferred embodiments thereof, many modifications and changes therein may be effected by those skilled in the art. Accordingly, it is intended by the appended claims to cover all such modifications and changes as fall within the true spirit and scope of the invention.

What is claimed is:

1. A method of fabricating a thin film transistor comprising the steps of:

depositing a first gate conductor layer on a major surface of a substrate;

depositing a second gate conductor layer over said first gate conductor layer, said second gate conductor layer being susceptible to etching under conditions under which said first gate conductor layer is substantially immune to etching;

providing a photoresist layer over said second gate conductor layer;

exposing and developing said photoresist in a pattern in accordance with a desired configuration of said first gate conductor layer;

etching said second gate conductor layer and said first gate conductor layer where they are not protected by the retained portion of said photoresist layer; then

etching back, with an etchant to which said first gate conductor layer is substantially immune, said second gate conductor layer to expose peripheral portions of said first gate conductor layer in a self aligned manner so as to form a patterned gate electrode having a gate conductor topology wherein said second gate conductor layer has sloped side-

walls set back a selected overlap distance from sidewalls of said first gate conductor layer, said selected overlap distance corresponding to the exposed peripheral portions of said first gate conductor layer;

removing any remaining photoresist;

depositing over said substrate and said first and second gate conductor layers a substantially conformal gate dielectric layer, depositing over said gate dielectric layer a substantially conformal semiconductor material layer, and depositing over said semiconductor material layer a substantially conformal source/drain metallization layer such that said gate conductor topography is propagated upward through each of said layers;

applying a planarization layer over said source/drain metallization layer;

planarizing said planarization layer to expose at least a portion of said source/drain metallization layer disposed over and corresponding to an uppermost portion of said patterned gate conductor topography; and

etching said source/drain metallization layer to form self-aligned source and drain electrodes disposed over said first gate conductor layer at least by said selected overlap distance.

2. The method recited in claim **1** wherein said first gate conductor layer is substantially transparent to at least one frequency in the infrared-to-ultraviolet portion of the electromagnetic spectrum.

3. The method recited in claim **1** wherein:

said semiconductor material is silicon.

4. The method recited in claim **1** wherein:

said semiconductor material is amorphous silicon.

5. A method of fabricating a thin film transistor comprising the steps of:

depositing a first gate conductor layer on a major surface of a substrate;

depositing a second gate conductor layer over said first gate conductor layer, said second conductor being susceptible to etching under conditions under which said first gate conductor layer is substantially immune to etching;

providing a photoresist layer over said second gate conductor layer;

exposing and developing said photoresist in a pattern in accordance with a desired configuration of said first gate conductor layer;

etching said second gate conductor layer and said first gate conductor layer where they are not protected by the retained portion of said photoresist layer; then

etching back, with an etchant to which said first gate conductor layer is substantially immune, said second gate conductor layer to expose peripheral portions of said first gate conductor layer in a self-aligned manner so as to form a patterned gate electrode having a gate conductor topology wherein said second gate conductor layer has sloped sidewalls set back a selected overlap distance from sidewalls of said first gate conductor layer, said selected overlap distance corresponding to the exposed peripheral portions of said first gate conductor layer;

depositing a substantially conformal dielectric layer over said patterned gate conductor and exposed portions of said substrate upper surface;

depositing a substantially conformal layer of semiconductor material over said dielectric layer;

depositing a layer of source/drain metallization over said semiconductor material layer;

forming a planarization layer of a planarization material over the source/drain metallization, said planarization layer having a substantially planar exposed surface;

uniformly removing said planarization material until said source/drain metallization is exposed in alignment with raised portions of said second gate conductor layer; and

selectively removing the exposed source/drain metallization to expose the underlying semiconductor material layer such that the remaining source/drain metallization is disposed over said patterned gate conductor by at least said selected overlap distance.

6. The method recited in claim **5** wherein:

the step of depositing the layer of semiconductor material comprises:

first depositing a layer of substantially undoped semiconductor material; and

second depositing a layer of doped semiconductor material; and

said method further comprises, after the step of selectively removing the source/drain metallization, the step of:

removing the doped semiconductor material portion of said semiconductor material layer.

7. The method recited in claim **6** wherein:

said semiconductor material is silicon.

8. The method recited in claim **7** wherein:

said semiconductor material is amorphous silicon.

9. The method recited in claim **5** wherein:

said semiconductor material is silicon.

10. The method recited in claim **9** wherein:

said semiconductor material is amorphous silicon.

11. The method recited in claim **5** further comprising the step of:

providing a back channel passivation layer over the structure.

12. The method recited in claim **5** wherein said first gate conductor layer is substantially transparent to at least one frequency in the infrared-to-ultraviolet portion of the electromagnetic spectrum.

13. A method of fabricating a thin film transistor comprising the steps of:

depositing a first gate conductor layer on a major surface of a substrate, said first gate layer being transmissive of at least one frequency of radiation capable of exposing photoresist;

depositing a second gate conductor layer over said first gate conductor layer, said second conductor layer being opaque to said at least one frequency of radiation and being susceptible to etching under conditions under which said first gate conductor layer is substantially immune to etching;

providing a photoresist layer over said second gate conductor layer;

exposing and developing said photoresist in a pattern in accordance with a desired configuration of said first gate conductor layer;

etching said second gate conductor layer and said first gate conductor layer where they are not protected by the retained portion of said photoresist layer; then

etching back, with an etchant to which said first gate conductor layer is substantially immune, said second gate conductor layer to expose peripheral portions of said first gate conductor layer in a self-aligned manner so as to form a patterned gate electrode having a gate conductor topology wherein said second gate conductor layer has sloped sidewalls set back a selected overlap distance from sidewalls of said first gate conductor layer, said selected overlap distance corresponding to the exposed peripheral portions of said first gate conductor layer;

depositing a first substantially conformal dielectric layer over said patterned gate conductor and exposed portions of said substrate upper surface;

depositing a substantially conformal layer of semiconductor material on said dielectric layer;

depositing a second layer of photoresist on the second dielectric layer;

exposing a back-side substrate surface, opposite to said major substrate surface, to UV light for a selected duration, to cause exposure of at least a portion of the second photoresist layer outside of a shadow of the opaque portion of said gate electrode;

removing at least the exposed second photoresist portion by selective development, to form a mask for etching the second dielectric layer;

etching said second dielectric layer to remove the portions not protected by the retained portion of said second photoresist;

depositing a layer of doped semiconductor material on the exposed semiconductor portion and over the remaining portion of the second dielectric layer;

depositing a layer of source/drain metallization over said doped semiconductor material layer;

forming a planarization layer of a planarization material over the source/drain metallization, said planarization layer having a substantially planar exposed surface;

uniformly removing said planarization material until said source/drain metallization is exposed in alignment with raised portions of said patterned gate conductor; and

selectively etching the exposed portion of the source/drain metallization and a portion of the doped semiconductor layer, to expose at least a top surface of the remaining portion of said second dielectric layer, and to form self-registered source and drain electrodes each of which overlaps the gate electrode at least by said selected overlap distance.

* * * * *

EXHIBIT 7

United States Patent [19]

Miyago et al.

[11] **Patent Number: 5,036,370**

[45] **Date of Patent: Jul. 30, 1991**

[54] **THIN FILM SEMICONDUCTOR ARRAY DEVICE**

[75] Inventors: **Makoto Miyago, Higashiosaka; Hiroshi Oka, Shiki; Akihiko Imaya, Nara; Hiroaki Kato, Nara; Takayoshi Nagayasu, Nara; Toshihiko Hirobe, Sakai, all of Japan**

[73] Assignee: **Sharp Kabushiki Kaisha, Japan**

[21] Appl. No.: **545,955**

[22] Filed: **Jul. 2, 1990**

[30] **Foreign Application Priority Data**

Jul. 4, 1989 [JP] Japan 1-173783

[51] **Int. Cl.**[5] **H01L 27/12**; H01L 27/01; H01L 29/78; H01L 23/48

[52] **U.S. Cl.** **357/4**; 357/23.7; 357/23.15; 357/71

[58] **Field of Search** 357/4, 23.7, 23.1, 71, 357/23.15

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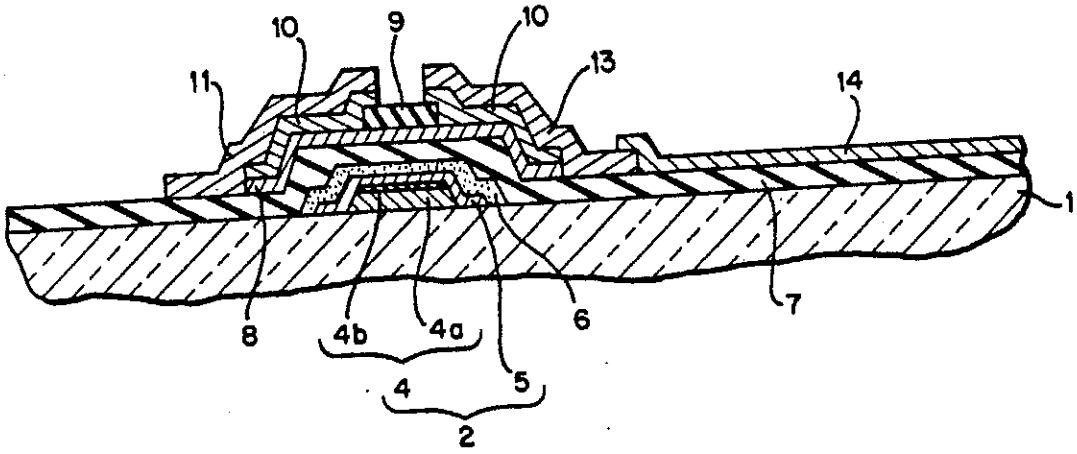
Primary Examiner—Mark Prenty
Attorney, Agent, or Firm—Nixon & Vanderhye

[57] **ABSTRACT**

The production of a thin film transistor array device having a gate wiring on an insulated substrate. The gate wiring has an inner gate wiring having a first metal layer formed on the insulated substrate and a second metal layer whose etching speed is faster than that of the first metal layer, the first metal layer and the second metal layer being overlapped so as to constitute a dual structure, and an outer gate wiring covering the inner gate wiring.

3 Claims, 4 Drawing Sheets



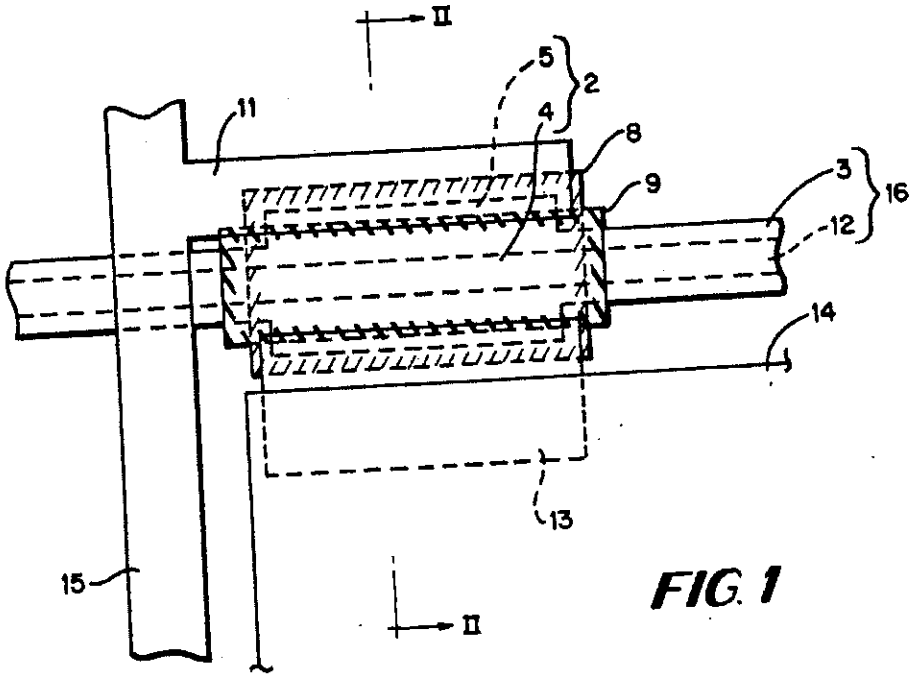


FIG. 1

FIG. 2

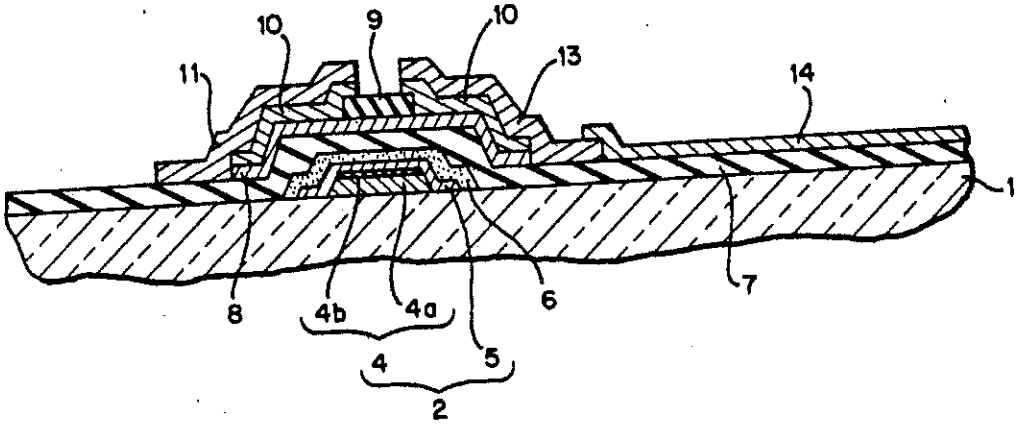


FIG. 3A

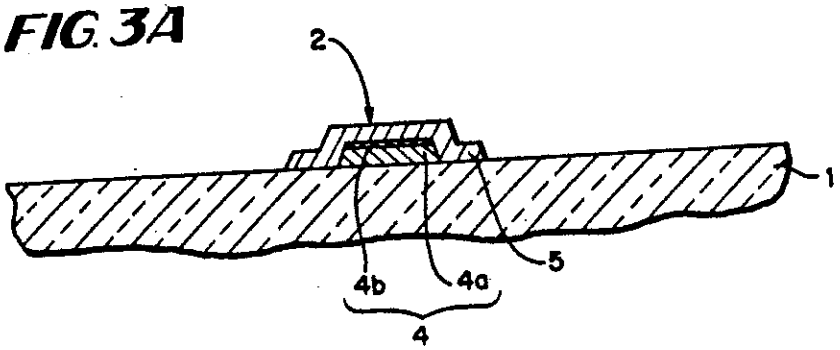


FIG. 3B

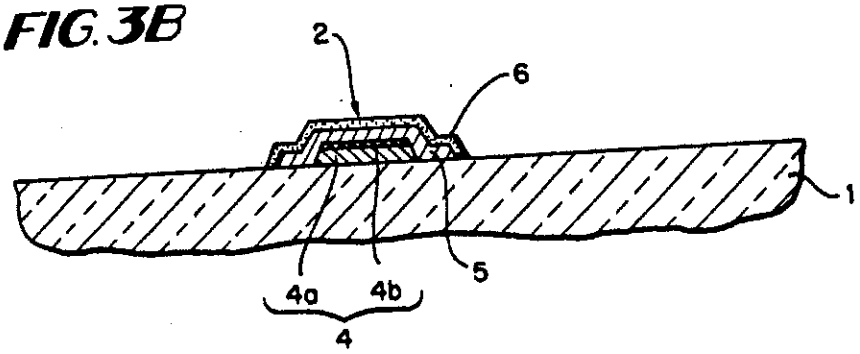


FIG. 3C

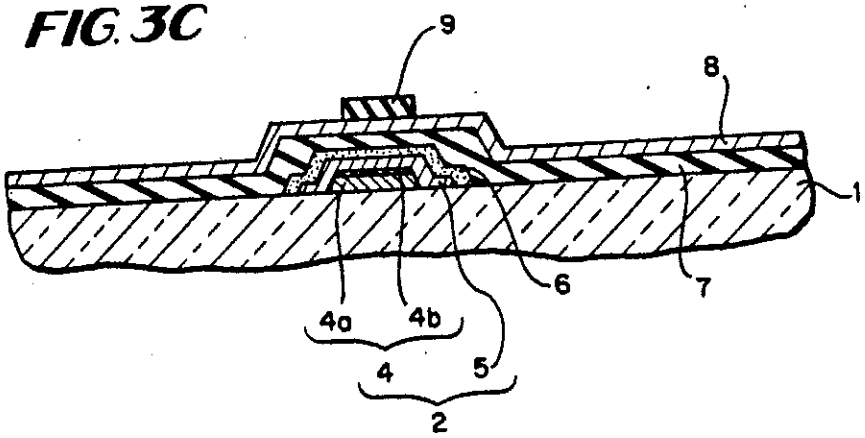


FIG. 3D

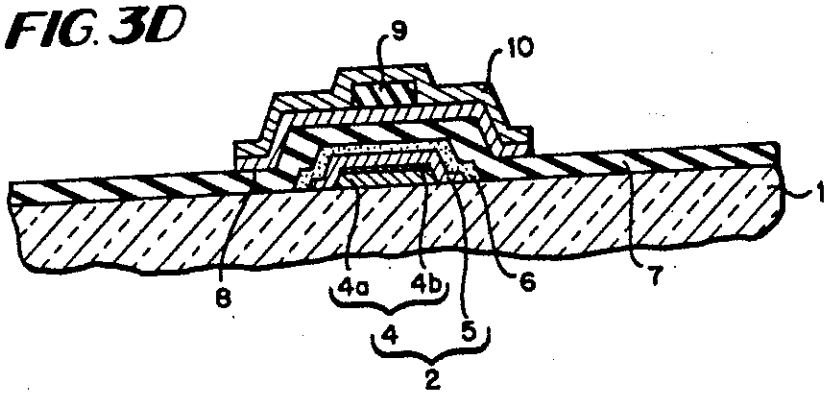


FIG. 3E

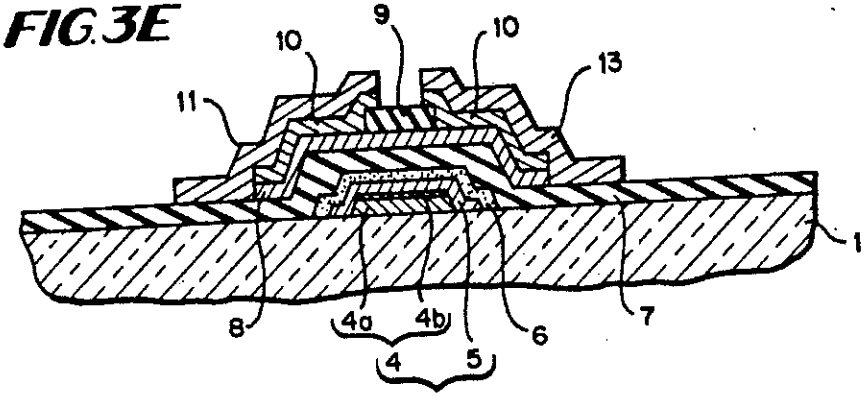


FIG. 3F

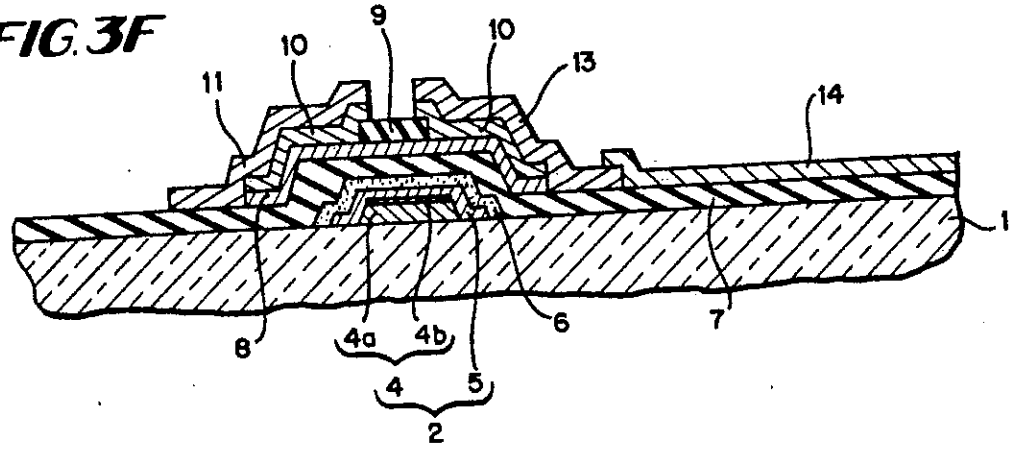


FIG. 4

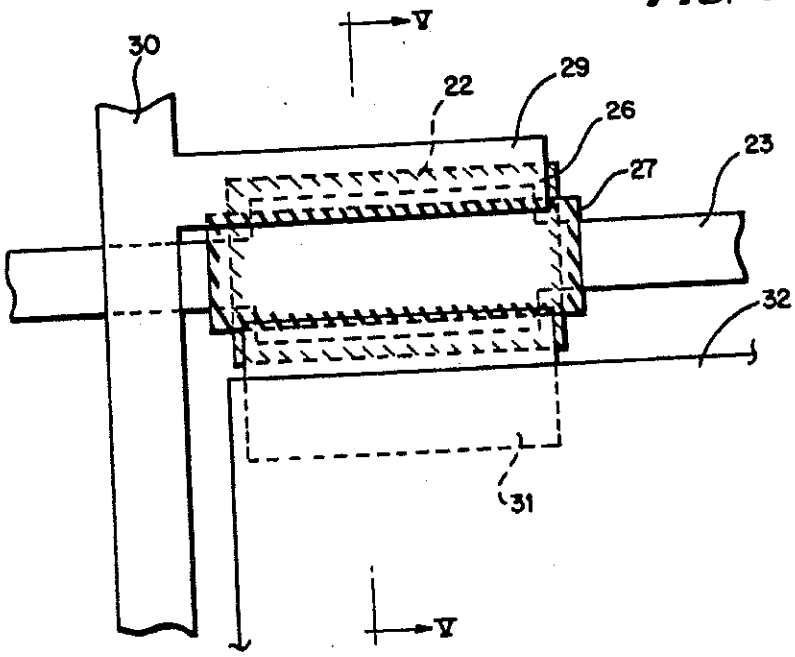


FIG. 5

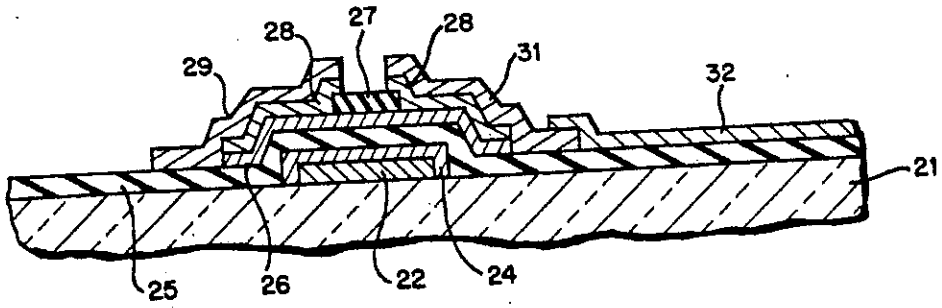
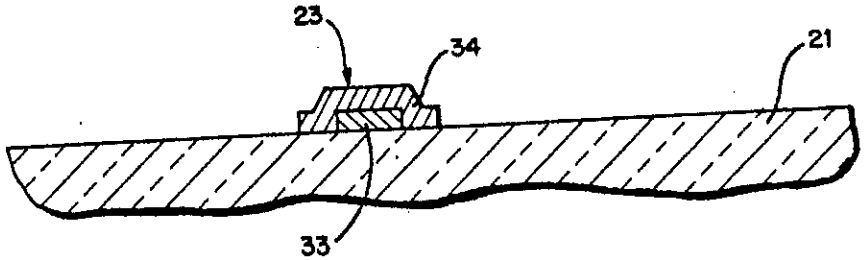


FIG. 6



THIN FILM SEMICONDUCTOR ARRAY DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to a transistor array device, and a method for producing the same. More particularly, the present invention relates to a thin film transistor array device adapted for use in large-screen active matrix display devices and a method for producing the same. Hereinafter, the thin film transistor will be referred to as "TFT".

2. Description of the Prior Art

Liquid crystal display devices which employ an active matrix system having a TFT array formed on an insulated substrate so as to drive picture element electrodes through the TFT are well known. The active matrix system has an advantage in that it can be applied to display devices designed to display on a large-scale screen with high density, whether the display is to be a reflecting type or a permeating type.

To obtain the TFT arrays, amorphous silicone (hereinafter referred to as "a-Si") or polycrystalline silicone is used as semiconductor material. FIG. **4** shows a conventional TFT array in which the rim of the layered portions is hatched with the central portion remaining unhatched for simplicity.

Referring to FIG. **5**, the conventional fabrication of a TFT array device will be described:

Tantalum (Ta) is deposited on a glass substrate **21** by a spattering method to a thickness of 3,000 to 4,000 Å, and gate wirings **23** are formed in patterns by a photolithography or by an etching method. The gate wirings **23** can be formed by a lift-off method. A wider portion of the gate wiring **23** functions as a gate electrode **22**. The surfaces of the gate electrode **22** and the gate wirings **23** are anodized so as to form an anodized film **24** which functions as a gate insulator film.

Subsequently, the anodized glass substrate **21** is covered with a gate insulating film **25**, to the thickness of 2,000 to 4,000 Å containing silicon nitride (hereinafter referred to as "SiNx") by a plasma activated chemical vapor deposition method (hereinafter referred to as plasma CVD method).

The gate insulator film **25** is covered with an a-Si(i) layer (150 to 1,000 Å thick) and then with a SiNx layer (100 to 2,000 Å thick). The a-Si layer later becomes a semiconductor layer **26**, and the SiNx layer later becomes an insulator layer **27**. Subsequently, the SiNx layer is formed in a desired pattern, and an insulator layer **27** is formed on a portion of the gate electrode **22** except for the outer part thereof.

The insulator layer **27** on the glass substrate **21** is covered with an a-Si(n+) layer (300 to 2,000 Å thick) doped with phosphorus, which layer becomes a contact layer **28** by a plasma CVD. Finally, the a-Si(i) layer and the a-Si(n+) layer are formed in a desired pattern to form the semiconductor layer **26**, and the contact layer **28** which is continuous on the insulator layer **27** at this stage.

A metal film of Mo, Ti, Al or the like is formed to the thickness of 2,000 to 10,000 Å on the glass substrate **21** so as to cover the semiconductor layer **26** and the contact layer **28**, and the metal film is formed in pattern by etching so that a source electrode **29**, a source bus **30** and a drain electrode **31** are formed. In this way a TFT is formed. The contact layer **28** is also subjected to the etching on insulator layer **27**, thereby separating into a first portion under the source electrode **29** and a second portion under the drain electrode **31**. Finally, the source electrode **29**, the source bus **30** and the drain electrode **31** are entirely covered with an indium tin oxide (ITO) film by spattering. The ITO film is formed in a desired pattern to form a picture element electrode **32**.

Such TFTs are formed in plurality on the gate wiring **23** to form the TFT array. The source bus **30** is perpendicular to the extension of the gate wiring **23**, and is connected to the respective source electrodes **29** of the TFTs.

In the active matrix display device employing the TFT arrays the scanning signals are consecutively input to the gate wiring **23**, and picture element signals are input to the source bus **30** to drive the picture element electrode **32**. The gate wiring **23** and the source bus **30** have 307,200 junctions in a display device having picture elements of 480×640. If leak occurs at one of these picture elements between the gate wiring **23** and the source bus **30**, a cross-type line failure occurs. This line failure spoils the quality of the image, and reduces the efficiency of the display device.

In the known display device described above, Ta is used for the gate wiring **23** because of its capability of being coated with an anodized film **24** whereby the gate wiring **23** and the source bus **30** are insulated. When the gate wiring **23** is made of Ta, an advantage is that the gate wiring **23** has a smooth tapered side, which prevents the source bus **30** from breakage at its junctions.

On the other hand, a disadvantage is that in a large-scale display device having a long gate wiring **23**, the scanning signals attenuate because of Ta having a large specific resistance. As a result, the brightness of picture elements are different between two points adjacent to the input section of the signals and remote from the input section, thereby resulting in tbe detrimental brightness gradient in picture elements spreading from the input section.

In order to solve such problems, one proposal shown in FIG. **6** is that the gate wiring has a dual layer structure, that is, an inner gate wiring **33** of metal having low specific resistance such as Al, Al-Si, or Al-Si-Cu, and an outer gate wiring **34** of the Ta. The advantage of this structure is that the inner gate wiring **33** avoids the undesired production of brightness gradient.

To prevent leaks from occurring at a junction by use of gate wirings **23** having the dual layer structure, it is essential to completely cover the inner gate wiring **33** with the outer gate wiring **34**. This is because in the process of forming the outer gate wiring **34** of Ta in pattern by etching, the etching speed of Al and other metals is higher than the etching speed of Ta. However, the inner gate wiring **33** of Al, Al-Si, or Al-Si-Cu cannot be formed so as to have a smooth inclined side. The rough sides are likely to cause the outer gate wiring **34** overlaying the inner gate wiring **33** to break. If the outer gate wiring **34** is broken in this way, the coverage of the inner gate wiring **33** fails. In addition, in the process of removing the resist after the inner gate wiring **33** is formed, the inner gate wiring **33** is liable to hillocks and voids. If the killocks and voids occur on the inner gate wiring **33**, its complete coverage becomes impossible. This causes leaks between the gate wiring **23** and the source bus **30** regardless of the existence of a gate insulating film **25**.

SUMMARY OF THE INVENTION

The transistor array device of the present invention, which overcomes the above-discussed and numerous other disadvantages and deficiencies of the prior art, comprises a gate wiring on an insulated substrate, the gate wiring comprising an inner gate wiring having a first metal layer formed on the insulated substrate and a second metal layer whose etching speed is faster than that of the first metal layer, the first metal layer and the second metal layer being overlapped so as to constitute a dual structure, and an outer gate wiring covering the inner gate wiring.

In a preferred embodiment, the inner gate wiring has a smaller specific resistance than that of the outer gate wiring.

In another preferred embodiment, the outer gate wiring is covered with an anodizing film.

According to another aspect of the present invention, there is provided a process for constructing a thin film transistor array device having a gate wiring on an insulated substrate, the process comprising the steps of overlapping a first metal layer over a second metal layer whose etching speed is faster than that of the first metal layer, forming an inner gate wiring in pattern on the first and second metal layers, and covering the inner gate wiring with an outer gate wiring.

In a preferred embodiment, the process further comprises a step of forming an anodized film on the outer gate wiring.

Thus, the invention described herein achieves the objects of (1) providing a thin film transistor array device having a gate wiring capable of anodizing, thereby reducing the specific resistance of the gate wiring, and (2) providing a thin film transistor array device capable of enhancing the image quality when it is applied to a large-screen display, thereby, increasing the efficiency of the display device and reducing the production cost.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention may be better understood and its numerous objects and advantages will become apparent to those skilled in the art by reference to the accompanying drawings as follows:

FIG. 1 is a plan view showing a transistor array device according to the present invention;

FIG. 2 is a cross-sectional view taken along the line II—II in FIG. 1;

FIGS. 3A to 3F are cross-sectional views explaining the steps of constructing the transistor array device of FIG. 1;

FIG. 4 is a plan view showing a conventional TFT semiconductor array device;

FIG. 5 is a cross-sectional view taken along the line V—V line in FIG. 4; and

FIG. 6 is a cross-sectional view showing an modified example of the gate wiring.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1, 2 and 3A–3F, and Al layer 4*a* (1,000 Å thick), and an Mo layer 4*b* (500 Å thick) were consecutively deposited on a galss substrate 1 by a spattering method. A desired shape of etching mask was formed on the Mo layer 4*b* with a photo resist film, and etching was carried out in accordance with the etching mask so that an inner gate wiring 12 was formed as shown in FIG. 1. A part of the inner gate wiring 12 is used as an inner gate electrode 4. Each of the inner gate wiring 12 and the inner gate electrode 4 has a width of 15 μm.

Subsequently, a Ta layer (3,000 Å thick) was deposited on the Mo layer 4*b*, and an outer gate wiring 3 and an outer gate electrode 5 were formed in pattern, each of which had a greater width by 1 μm or more than those of the inner tape wiring 12 and the inner gate electrode 4 (FIG. 3A). A rim portion of the outer gate wiring 3 is used as the outer gate electrode 5. In the illustrated example the inner gate wiring 12 and the outer gate wiring 3 constitute the gate wiring 16. Likewise, inner gate electrode 4 and the outer gate electrode 5 constitute the gate electrode 2.

The top surfaces of the outer gate electrode 5 and the outer gate wiring 3 were anodized so as to form an anodized film 6 consisting of Ta_2O_5 and functioning as a gate insulating film as shown in FIG. 3B. Since the Ta_2O_5 film is resistant to etching, it protects the outer gate electrode 5, the outer gate wiring 3, the inner gate wiring 12 and the inner gate electrode 4 against an etchant used in a later etching for forming TFTs.

The entire surface of the glass substrate 1 was covered with a gate insulating film 7 (4,000 Å thick) consisting of SiNx by a plasma CVD method. the gate insulating film 7 is covered with an a-Si(i) layer (300 Å thick) which later becomes a semiconductor layer 8, and a SiNx layer (2,000 Å thick) which later becomes an insulating layer 9 in this order. The SiNx layer was formed in a desired pattern, and the insulating layer 9 was formed only above the gate electrode 2 (FIG. 3C).

The glass substrate 1 and the insulating layer 9 thereon was covered with an a-Si(n^+) layer (1,000 Å thick) by a plasma CVD method. Then, the a-Si(i) layer and a-Si(n^+) layer were formed in pattern so that semiconductor layer 8 and the contact layer 10 were formed (FIG. 3D). The contact layer 10 functions as an ohmic contact among the semiconductor layer 8, the source electrode 11 and the drain electrode 13. At this stage, the contact layer 10 is continuous on the insulating layer 9.

The entire surface of this glass substrate 1 was covered with a Ti layer (3000 Å thick) which was formed in pattern by etching to form the source electrode 11 and the drain electrode 13. At this stage, the contact layer 10 on the insulating layer 9 was removed by etching, thereby separating into two portions below the source electrode 11 and the drain electrode 13 (FIG. 3E). The source wiring 15 crossing the gate wiring 16 was formed at this time. In this way, the TFT array device is obtained.

Subsequently, the entire surface of the glass substrate 1 was covered with an ITO film by spattering. The ITO film was formed in a desired pattern, thereby forming a picture element electrode 14 (FIG. 3F). In this way an active matrix substrate is formed.

The TFT array device of the present invention has a gate wiring 16 which includes an inner gate wiring 12 having an Al layer 4*a* and an Mo layer 4*b* overlapped in this order, and an outer gate wiring 3 of Ta covering the inner gate wiring 12. Because of the small specific resistance of the gate wiring 16 which is composed of the Al layer 4*a* and the Mo layer 4*b*, the picture elements which are represented by the picture element electrode 14 connected to the same gate wiring 16 are prevented from a detrimental brightness gradient.

Since the inner gate wiring 12 is constituted with a dual layer having the Al layer 4*a* and the Mo layer 4*b*

overlapped, the Al layer **4***a* is protected from hillocks and voids. In addition, since the etching speed at which the Mo layer **4***b* forms the inner gate wiring **12** and the inner gate electrode **4** is faster than that by the Al layer **4***a* with respect to the etchant, the cross-section of the inner gate wiring **12** becomes tapered by its width becoming smaller progressively from the glass substrate **1**.

Since the outer gate wiring **3** is wider than the inner gate wiring **12**, the tapered inner gate wiring **12** is completely covered with the outer gate wiring **3**. Owing to the coverage tbe inner gate wiring **12** is kept safe from an etching liquid. After the outer gate wiring **3** is formed and its surface is covered with the anodized film **6**, the gate wiring **16** has a tapered side, thereby ensuring that the source wirings **15** crossing the gate wiring **16** are kept safe from breakage.

As described above, the gate electrode **2** is protected from breakage because of its smooth side surface and smooth top surface like the gate wiring **16**. A TFT layer **8** overlaid thereon through a gate insulating film is also protected from detrimental breakage. Thus, the TFT layer **8** can be made thin without trading off the effectiveness. Thin TFT semiconductor layers **8** increase resistance during the gate-off period. A large gate-off resistance maintains the potential of the picture element electrode **14** at a high level until a subsequent scanning signal is input.

It is understood that various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the scope and spirit of this invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth herein, but rather that the claims be construed as encompassing all the features of patentable novelty that reside in the present invention, including all features that would be treated as equivalents thereof by those skilled in the art to which this invention pertains.

What is claimed is:

1. A thin film transistor array device having a gate wiring on an insulating substrate, the gate wiring comprising an inner gate wiring having a first metal layer formed on the insulating substrate and a second metal layer whose etching speed is faster than that of the first metal layer, the first metal layer and the second metal layer being overlapped so as to constitute a dual structure, and an outer gate wiring covering the inner gate wiring.

2. A thin film transistor array device according to claim **1**, wherein the inner gate wiring has a smaller specific resistance than that of the outer gate wiring.

3. A thin film transistor array device according to claim **1** or **2**, wherein the outer gate wiring is covered with an anodized film.

* * * * *

EXHIBIT 8

JC857 U.S. PTO 09/983629 10/25/01

ISSUE CLASSIFICATION: Class 438, Subclass 149

JC-538

PATENT NUMBER 6573127

6573127

U.S. UTILITY Patent Application

O.I.P.E. SCANNED TR3 Q.A. TM

PATENT DATE JUN 03 2003

APPLICATION NO.	CONT/PRIOR	CLASS	SUBCLASS	ART UNIT	EXAMINER
09/983629	D F	257~~438~~	149	2815~~2818~~	P. DANG

APPLICANTS: Hyun-Sik Seo

TITLE: Thin film transistor and method of making same

PTO-2040 12/00

ISSUING CLASSIFICATION

ORIGINAL CLASS	ORIGINAL SUBCLASS	CROSS REFERENCE(S) CLASS	CROSS REFERENCE(S) SUBCLASS (ONE SUBCLASS PER BLOCK)
438	149	438	937

INTERNATIONAL CLASSIFICATION: H01L 21/00; H01L 21/84

☐ Continued on Issue Slip Inside File Jacket

5/1/03 Formal Drawings (9 sht(s)) rec'd 10/25/01

☐ TERMINAL DISCLAIMER	DRAWINGS: Sheets Drwg.	Figs. Drwg.	Print Fig.	CLAIMS ALLOWED: Total Claims	Print Claim for O.G.
	9	20	6E	16	1

☐ The term of this patent subsequent to _____ (date) has been disclaimed.

☐ The term of this patent shall not extend beyond the expiration date of U.S Patent. No. _____

☐ The terminal ___ months of this patent have been disclaimed.

PHUC T. DANG (Assistant Examiner) 1/14/03 (Date)

David Nelms, Supervisory Patent Examiner, Technology Center 2800

(Primary Examiner) 1/03 (Date)

J.M. Baumeister (Legal Instruments Examiner) 1-24-03 (Date)

NOTICE OF ALLOWANCE MAILED: 4-23-03

ISSUE FEE (W)

Amount Due	Date Paid
1600	4-23-03

ISSUE BATCH NUMBER

WARNING:
The information disclosed herein may be restricted. Unauthorized disclosure may be prohibited by the United States Code Title 35, Sections 122, 181 and 368. Possession outside the U.S. Patent & Trademark Office is restricted to authorized employees and contractors only.

Form PTO-436A (Rev. 6/88)

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ISSUE FEE IN FILE

Formal Drawings (___ sht(s)) rec'd ___

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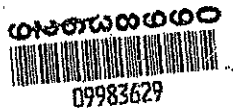

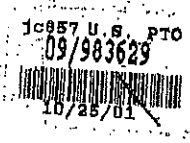

INITIALS KT

CONTENTS

	Date Received (Incl. C. of M.) or Date Mailed		Date Received (Incl. C. of M.) or Date Mailed
1. Application ____ papers.		42.	
2. IDS	10/25/01	43.	
3. Priority	10/25/01	44.	
4. Pre Amend A	10/25/01	45.	
5. 18 Rejection (3 months)	8/14/02	46.	
6. Appeal B	11-13-02	47.	
7. Drawing change	11-13-02	48.	
8. PTOL. 37	1/23/03	49.	
9.		50.	
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ISSUE SLIP STAPLE AREA (for additional cross references)

POSITION	INITIALS	ID NO.	DATE
FEE DETERMINATION	[illegible]		10-25-9[illegible]
O.I.P.E. CLASSIFIER			
FORMALITY REVIEW	[illegible]	536	01/15/02
RESPONSE FORMALITY REVIEW			

INDEX OF CLAIMS

✓ ..... Rejected
= ..... Allowed
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÷ ..... Restricted
N ..... Non-elected
I ..... Interference
A ..... Appeal
O ..... Objected

Claim		Date
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$52 01/16/02

PATENT
630-1536P

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant:	Hyun-Sik SEO	Conf.:	1252
Serial No.:	09/983,629	Art Unit:	2818
Filed:	October 25, 2001	Examiner:	P. Dang
For:	THIN FILM TRANSISTOR AND METHOD OF MAKING SAME		

AMENDMENT UNDER 37 C.F.R. §1.111

Assistant Commissioner for Patents
Washington, DC 20231

November 13, 2002

Sir:

In response to the Office Action dated August 14, 2002 (Paper No. 5), the following amendments and remarks are respectfully submitted in connection with the above-identified application:

IN THE CLAIMS:

Please **amend claims 11, 16, 20, and 26** as follows:

11. (Amended) A method of making a thin-film transistor, comprising the steps of:

depositing a first metal layer, formed of a metal exhibiting tensile stress, on a substrate;

depositing a second metal layer, formed of a material exhibiting compressive stress, on the first metal layer directly after the step of depositing the first metal layer;

forming a single photoresist having a predetermined width on the second metal layer;

patterning the second metal layer using the single photoresist as a mask;

patterning the first metal layer using the photoresist as a mask, the first metal layer being etched to have a width greater than a width of the second metal layer, wherein the second metal layer is formed only on a portion of the first metal layer, leaving two side portions on a horizontal upper surface of the first metal layer having no second metal layer formed thereon, thus forming a gate having a laminated structure of the first and second metal layers; and

removing the photoresist,

wherein the steps of patterning the second metal layer and the first metal layer each comprises a single etching step.

16. (Amended) The method of making a thin-film transistor as claimed in claim 15, wherein the second metal layer is formed from Mo, an Mo alloy, MoTa, MoW or MoNb.

20. (Amended) A method of making a thin-film transistor, comprising the steps of:

depositing a first metal layer on a substrate, the first metal layer exhibiting tensile stress;

depositing a second metal layer on the first metal layer without forming a photoresist on the first metal layer beforehand, the second metal layer exhibiting compressive stress;

forming a photoresist having a predetermined width on the second metal layer;

etching the first and second metal layers so that the first metal layer is wider than the second metal layer, wherein the second metal layer is formed only on a portion of the first

metal layer, leaving two side portions on a horizontal upper surface of the first metal layer having no second metal layer formed thereon, to form a gate electrode having a double-layered structure including the first and second metal layers;

removing the photoresist; and

forming a single gate insulating layer directly on at least one of the first and second metal layers such that the single gate insulating layer directly contacts at least one of the first and second metal layers.

26. (Amended) A method of making a thin-film transistor, comprising the steps of:

depositing a first metal layer on a substrate, the first metal layer being formed of a metal exhibiting tensile stress;

depositing a second metal layer on the first metal layer without forming a photoresist on the first metal layer beforehand, the second metal layer being formed of metal exhibiting compressive stress;

forming a single photoresist having a predetermined width on the second metal layer;

patterning the first and second metal layers simultaneously in a single etching step using the single photoresist as a mask, wherein the second metal layer is formed only on a portion of the first metal layer, leaving two side portions on a horizontal upper surface of the first metal layer having no second metal layer formed thereon; and

removing the photoresist.

REMARKS

Applicant thanks the Examiner for the thorough consideration given the present application.

Claims 11-26 are pending in this application. Claims 11, 20, and 26 are independent. Claims 11, 16, 20, and 26 are amended.

Reconsideration of this application, as amended, is respectfully requested.

Priority Under 35 U.S.C. §119

Applicant thanks the Examiner for acknowledging the claim for foreign priority under 35 U.S.C. §119, and receipt of the certified copy of the priority document in the parent application.

Information Disclosure Statement

The Examiner has acknowledged receipt of the Information Disclosure Statement filed October 25, 2001, and has returned an initialed copy of the Form PTO-1449. No further action is necessary at this time.

Drawings

The Examiner indicates on page 3 of the Office Action that source electrode 42 is not shown in FIG. 3. Included with the accompanying Letter to the Official Draftsperson is a proposed change to FIG. 3, and revised formal drawing therefor, showing source electrode 42. In view of this change and the indication in the Office Action Summary that the formal drawings filed with the present application are approved, The Examiner is respectfully requested to

provide a Notice of Draftsperson's Patent Drawing Review, Form PTO-948, confirming this approval with the next official communication.

Claim Objection

Claims 16 and 20 are objected to as containing informalities. The dependency of claim 16 has been corrected. The informality of claim 20 has been corrected. Accordingly, reconsideration of the objection to the claims is requested.

Rejections under 35 U.S.C. §103(a)

Claims 11, 12, 14-20, 22-25, and 26 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,235,561 to Seiki et al. Claims 13 and 21 are rejected as being unpatentable over Seiki et al. in view of U.S. Patent No. 6,300,152 to Kim. These rejections are respectfully traversed.

While not conceding the appropriateness of the Examiner's rejection, but merely to advance prosecution of the instant application, independent claims 11, 20 and 26 have been amended to recite combinations of method steps in a method of making a thin-film transistor including a "second metal layer ... formed only on a portion of the first metal layer, leaving two side portions on a horizontal upper surface of the first metal layer having no second metal layer formed thereon." Applicants respectfully submit that these combinations of method steps, as set forth in independent claims 11, 20 and 26, are not disclosed or made obvious by the prior art of record, including Seiki et al. or Kim.

In contrast to Applicant's claimed invention, Seiki et al. merely show depositing an aluminum film 110, a molybdenum film 112, and a photoresist 17 on a glass substrate 100, as shown in FIGS. 6a-6c. The layers are etched such that a third conductive molybdenum layer 113 is formed on an entire upper surface of the first conductive aluminum layer 111. Seiki et al. do not teach or suggest a second metal layer formed only on a portion of the first metal layer, leaving two side portions on a horizontal upper surface of the first metal layer having no second metal layer formed thereon, as set forth in the presently claimed invention.

In rejecting claims 13 and 21, the Office Action relies on Kim for teachings of forming a second insulating layer covering a semiconductor layer, a source electrode, a drain electrode and a first insulating layer. The effective filing date of the present application is August 26, 1997 since the present application is a divisional of U.S. Patent Application No. 08/918,462, now U.S. Patent No. 6,333,518. Because Kim's filing date of December 27, 1999, is later than the effective filing date of the present application, Kim cannot be used as prior art against the claims of the present application. Furthermore, Kim does not teach or suggest the above-cited features of claims 11 and 20, incorporated in claims 13 and 21 and, therefore, fails to cure the deficiencies of Seiki et al.

Applicants submit that claims 12-19 and 21-25 depend, either directly or indirectly, from independent claims 11 and 20, which are allowable for the reasons set forth above, and therefore claims 12-19 and 21-25 are allowable based on their dependence from claims 11 and 20. Reconsideration and allowance thereof are respectfully requested.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant, therefore, respectfully requests that the Examiner reconsider the outstanding objection and rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action, and that the present application is in condition for allowance.

If the Examiner believes for any reason that personal communication will expedite prosecution of this application, he is invited to telephone Sam Bhattacharya, Reg. No. 48,107, at (703) 205-8000.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17, particularly extension of time fees.

Respectfully submitted,
BIRCH, STEWART, KOLASCH & BIRCH, LLP

By: James T. Eller, Jr.
James T. Eller, Jr.
Reg. No. 39,538

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630-1536P
Attachment
JTE:SB:rk
39

MARKED-UP COPY OF AMENDMENTS

Claims 11, 16, 20, and 26 are amended as follows:

11. (Amended) A method of making a thin-film transistor, comprising the steps of:

depositing a first metal layer, formed of a metal exhibiting tensile stress, on a substrate;

depositing a second metal layer, formed of a material exhibiting compressive stress, on the first metal layer directly after the step of depositing the first metal layer;

forming a single photoresist having a predetermined width on the second metal layer;

patterning the second metal layer using the single photoresist as a mask;

patterning the first metal layer using the photoresist as a mask, the first metal layer being etched to have a width greater than a width of the second metal layer, wherein the second metal layer is formed only on a portion of the first metal layer, leaving two side portions on a horizontal upper surface of the first metal layer having no second metal layer formed thereon, thus forming a gate having a laminated structure of the first and second metal layers; and

removing the photoresist[;],

wherein the steps of patterning the second metal layer and the first metal layer each [comprise] comprises a single etching step.

16. (Amended) The method of making a thin-film transistor as claimed in claim [9] 15, wherein the second metal layer is formed from Mo, [a] an Mo alloy, MoTa, MoW or MoNb.

20. (Amended) A method of making a thin-film transistor, comprising the steps of:

depositing a first metal layer on a substrate, the first metal layer exhibiting tensile stress;

depositing a second metal layer on the first metal layer without forming a photoresist on the first metal layer beforehand, the second metal layer exhibiting compressive stress;

forming a photoresist having a predetermined width on the second metal layer;

etching the first and second metal layers so [such] that the first metal layer is wider than the second metal layer, wherein the second metal layer is formed only on a portion of the first metal layer, leaving two side portions on a horizontal upper surface of the first metal layer having no second metal layer formed thereon, to form [agate] a gate electrode having a double-layered structure including the first and second metal layers;

removing the photoresist; and

forming a single gate insulating layer directly on at least one of the first and second metal layers such that the single gate insulating layer directly contacts at least one of the first and second metal layers.

26. (Amended) A method of making a thin-film transistor, comprising the steps of:

depositing a first metal layer on a substrate, the first metal layer being formed of a metal exhibiting tensile stress;

depositing a second metal layer on the first metal layer without forming a photoresist on the first metal layer beforehand, the second metal layer being formed of metal exhibiting compressive stress;

forming a single photoresist having a predetermined width on the second metal layer;

patterning the first and second metal layers simultaneously in a single etching step using the single photoresist as a mask, wherein the second metal layer is formed only on a portion of the first metal layer, leaving two side portions on a horizontal upper surface of the first metal layer having no second metal layer formed thereon; and

removing the photoresist.

EXHIBIT 9

US007075595B2

(12) **United States Patent**
Moon

(10) **Patent No.: US 7,075,595 B2**
(45) **Date of Patent: Jul. 11, 2006**

(54) **LIQUID CRYSTAL DISPLAY DEVICE ARRAY SUBSTRATE AND METHOD OF MANUFACTURING THE SAME**

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(73) Assignee: **LG. Phillips LCD Co., Ltd.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 446 days.

(21) Appl. No.: **10/690,578**

(22) Filed: **Oct. 23, 2003**

(65) **Prior Publication Data**

US 2004/0080681 A1 Apr. 29, 2004

Related U.S. Application Data

(62) Division of application No. 09/867,484, filed on May 31, 2001, now Pat. No. 6,664,569.

(30) **Foreign Application Priority Data**

Jun. 9, 2000 (KR) 2000-31848

(51) **Int. Cl.**
G02F 1/136 (2006.01)
G02F 1/1343 (2006.01)

(52) **U.S. Cl.** **349/46**; 349/139
(58) **Field of Classification Search** 349/46, 349/139, 43; 257/59, 72

See application file for complete search history.

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Primary Examiner—Toan Ton
(74) *Attorney, Agent, or Firm*—McKenna Long & Aldridge LLP

(57) **ABSTRACT**

An array substrate for use in a liquid crystal display device includes a thin film transistor as a switching element, having a gate electrode, a source electrode and a drain electrode, wherein the gate electrode is a portion of a gate line near the crossing of the gate and data lines, and has an inverted "T"-shaped opening or a rectangularly-shaped opening. The drain electrode is shaped like the inverted "T"-shape and corresponds to the opening of the gate electrode. The source electrode surrounds the drain electrode along the steps of the semiconductor layer. Accordingly, in the thin film transistor having this structure, the gate electrode is only overlapped by the edges of the drain electrode. And thus, the gate-drain parasitic capacitance is reduced and minimized. Also, variations in the gate-drain parasitic capacitance are prevented. As a result, a high resolution is achieved and the picture quality is improved in the liquid crystal display device.

7 Claims, 8 Drawing Sheets

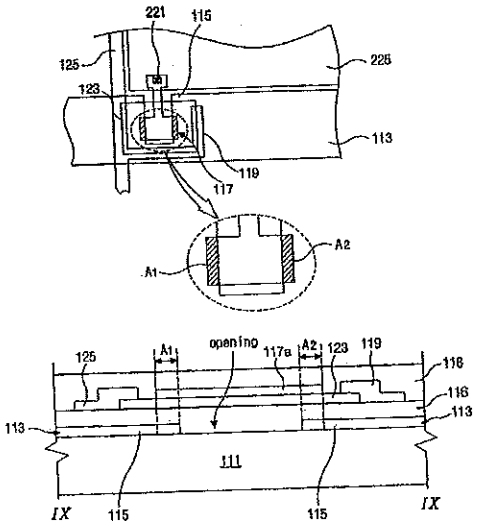


FIG.1
(RELATED ART)

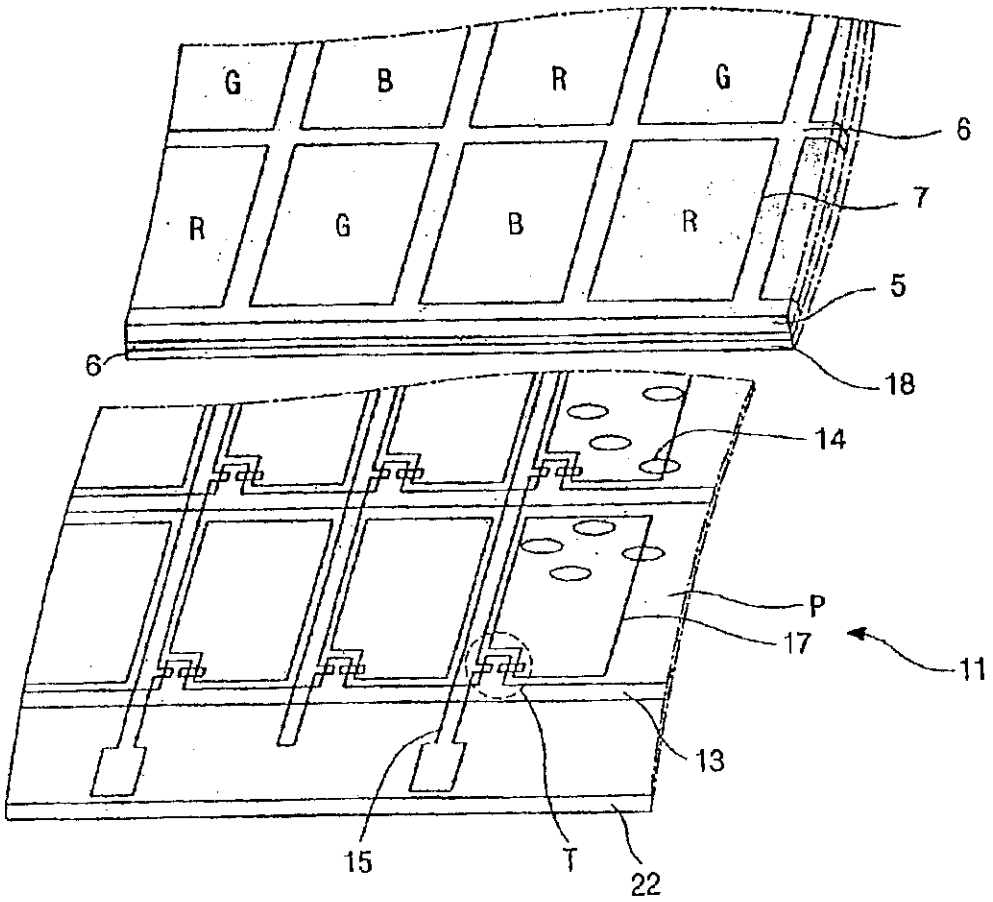


FIG.2
(RELATED ART)

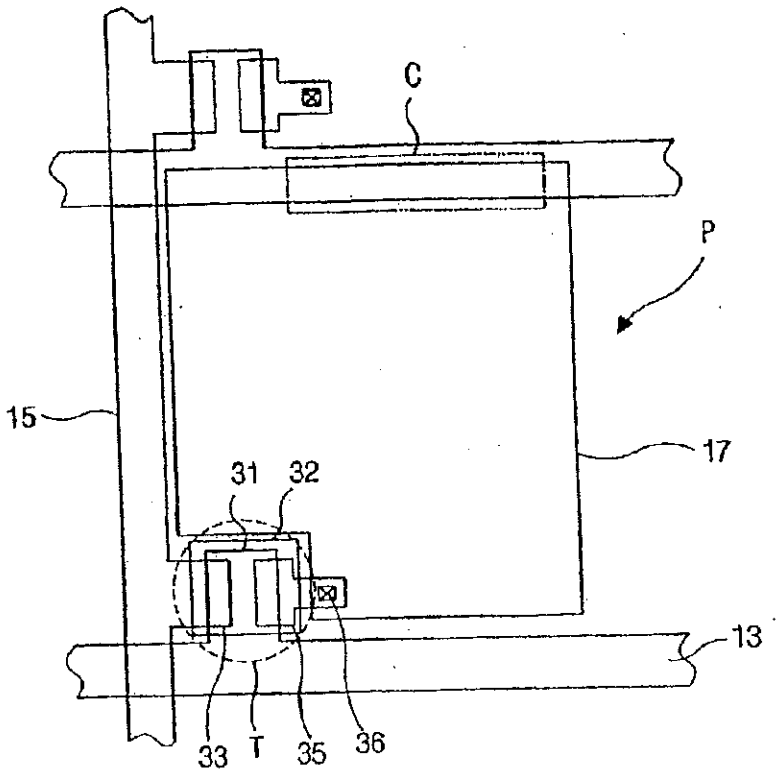


FIG.3
(RELATED ART)

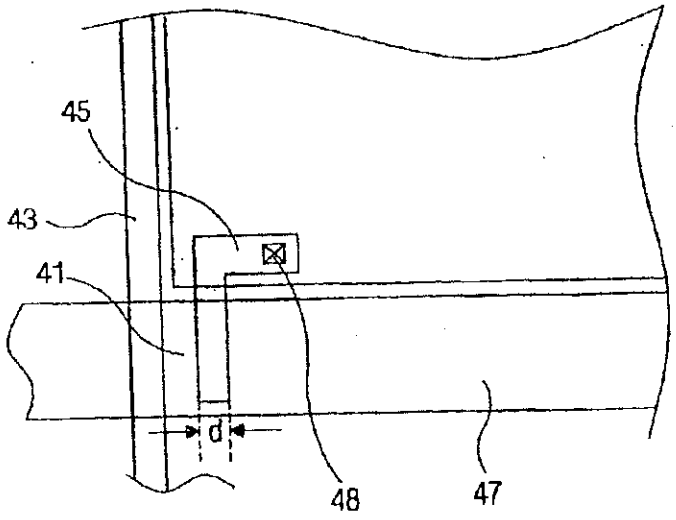


FIG.4
(RELATED ART)

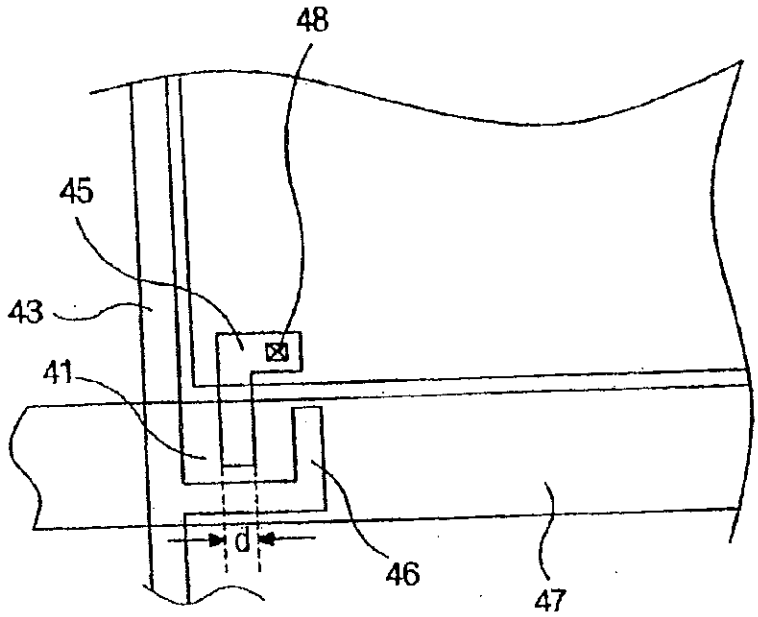


FIG.5

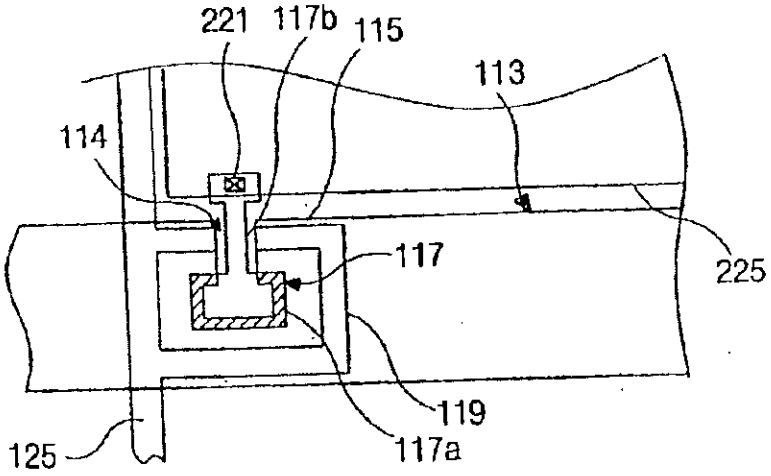


FIG.6A

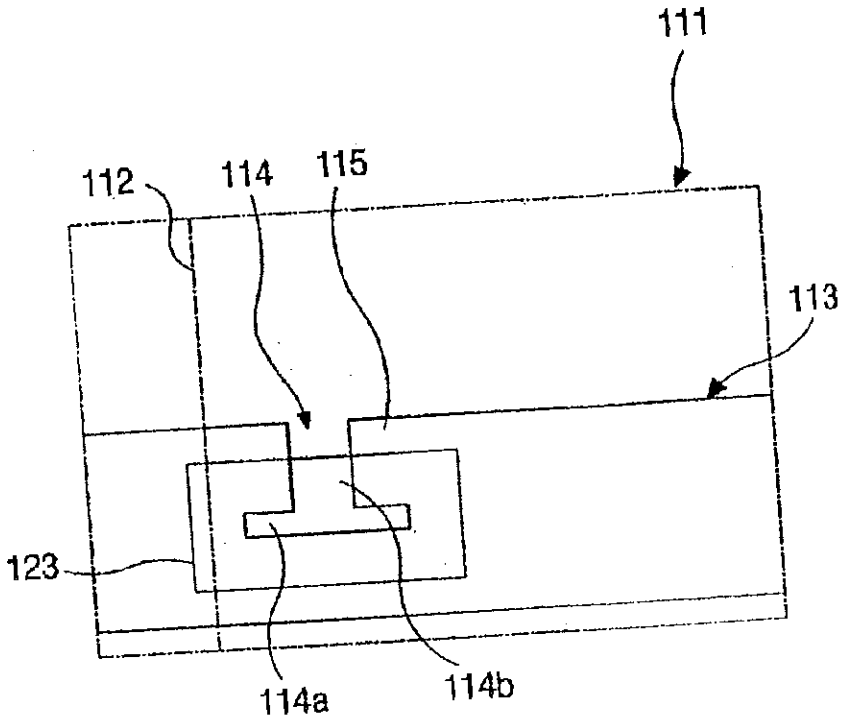


FIG.6B

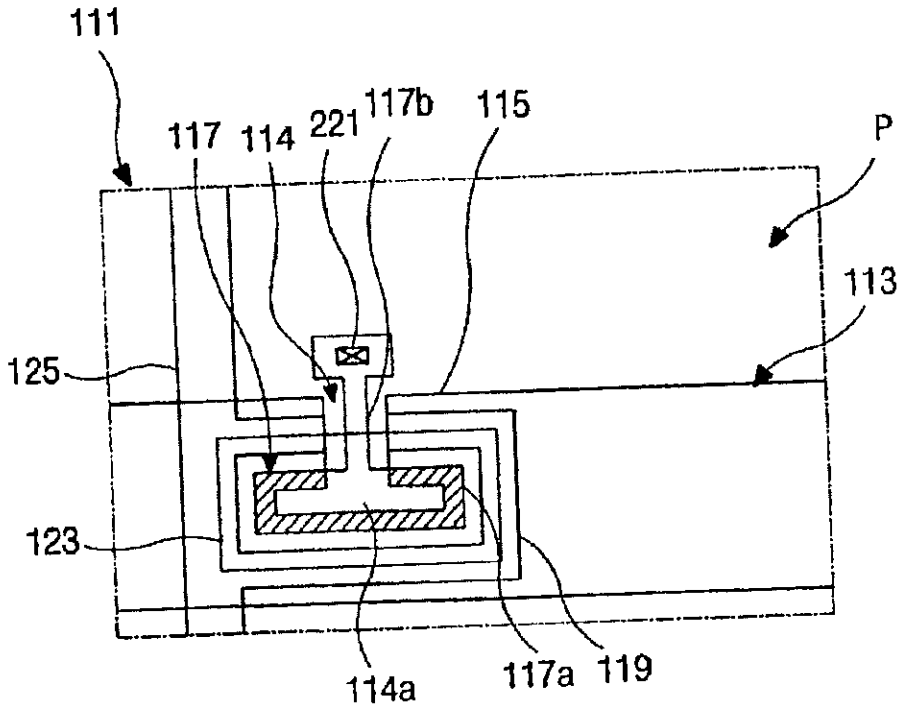


FIG.6C

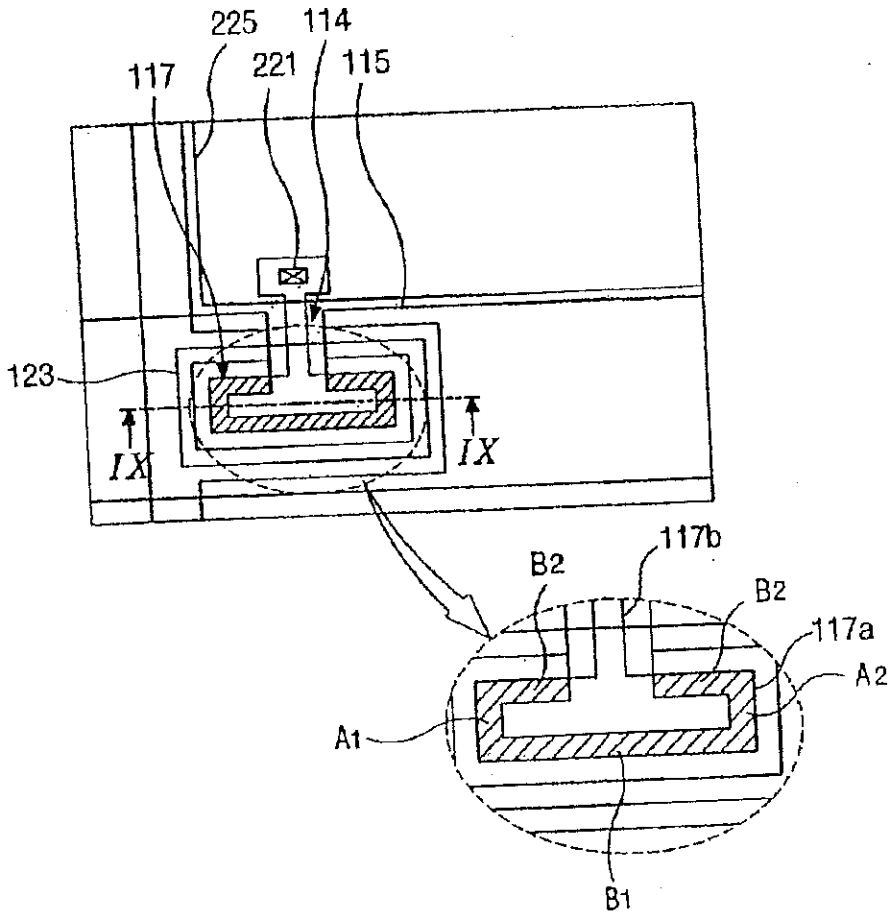


FIG.7

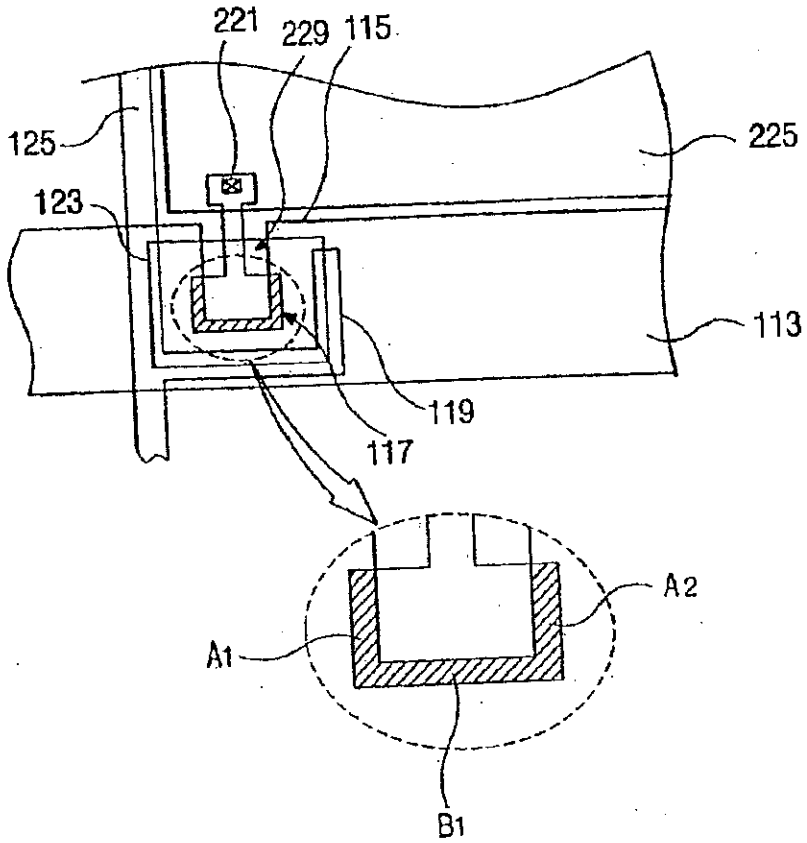


FIG.8

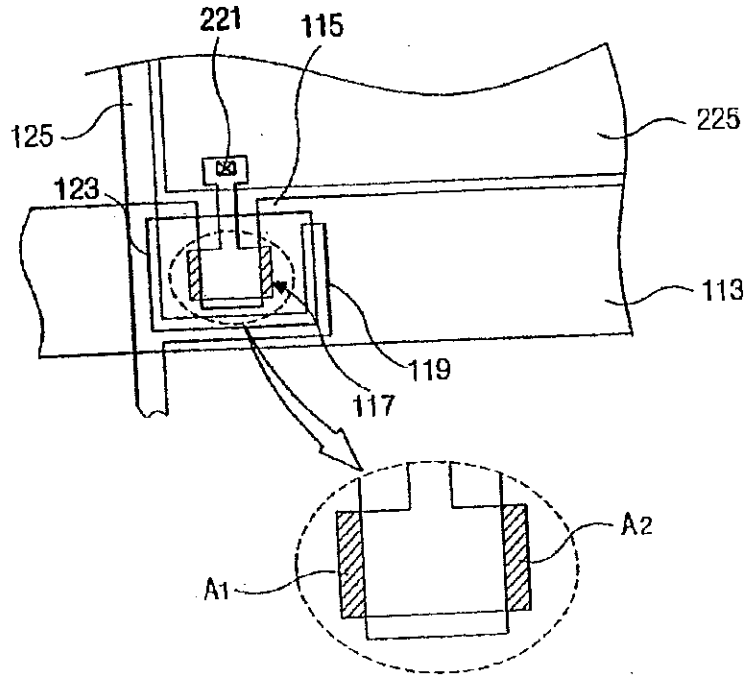
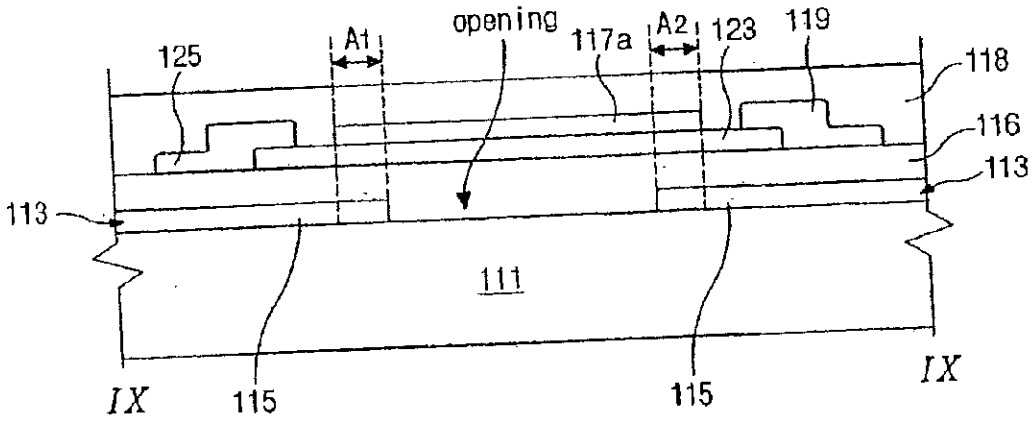

221
115
125
225
123
113
119
117
A2
A1

FIG.9


opening
A1
A2
125
117a
123
119
118
116
113
113
111
IX
115
115
IX

LIQUID CRYSTAL DISPLAY DEVICE ARRAY SUBSTRATE AND METHOD OF MANUFACTURING THE SAME

This application is a divisional of prior application Ser. No. 09/867,484, filed May 31, 2001 now U.S. Pat. No. 6,664,569.

This application claims the benefit of Korean Patent Application No. 2000-31848, filed on Jun. 9, 2000, the entirety of which is hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an array substrate for use in a liquid crystal display (LCD) device, and more particularly, an array substrate having a thin film transistor (TFT) with a reduced parasitic capacitance.

2. Discussion of the Related Art

FIG. **1** shows the configuration of a typical TFT-LCD device. The TFT-LCD device **11** includes upper and lower substrates **5** and **22** with an interposed liquid crystal material **14**. The upper and lower substrates **5** and **22** are generally referred to as a color filter substrate and an array substrate, respectively.

On the upper substrate **5**, on a surface opposing the lower substrate **22**, black matrix **6** and color filter layer **7**, including a plurality of red (R), green (G), and blue (B) color filters, are formed in the shape of an array matrix, such that each color filter is surrounded by the black matrix **6**. Also, on the upper substrate **5** a common electrode **18** is formed covering the color filter layer **7** and the black matrix **6**.

On the lower substrate **22**, on a surface opposing the upper substrate **5**, a thin film transistor (TFT) "T", as a switching device, is formed in the shape of an array matrix corresponding to the color filter layer **7**, and a plurality of crossing gate and data lines **13** and **15** are positioned such that each TFT "T" is located near each crossover point of the gate and data lines **13** and **15**. Also, on the lower substrate **22** a plurality of pixel electrodes **17** are formed in an area defined by the gate and data lines **13** and **15**. The area defined thereby is called a pixel region "P". The pixel electrode **17** is usually formed from a transparent conductive material having good transmissivity, for example, indium-tin-oxide (ITO) or indium-zinc-oxide (IZO).

The pixel and common electrodes **17** and **18** generate electric fields that control the light passing through the liquid crystal cells provided therebetween. By controlling the electric fields, desired characters or images are displayed.

The operation of the TFT-LCD device having the above-mentioned structure is based on the a principle that the alignment direction of the liquid crystal molecules depends on an applied electric field. Namely, the liquid crystal layer having a spontaneous polarization characteristic is a dielectric anisotropy material. The liquid crystal molecules have dipole moments based on the spontaneous polarization when a voltage is applied. Thus, the alignment direction of the liquid crystal molecules is controlled by applying an electric field to the liquid crystal molecules. When the alignment direction of the liquid crystal molecules is properly adjusted, the liquid crystals are aligned and light is refracted along the alignment direction of the liquid crystal molecules to display image data. The liquid crystal molecules function as an optical modulation element having optical characteristics that vary depending upon the polarity of the applied voltage.

FIG. **2** is a plan view illustrating one pixel of an array substrate for the liquid crystal display device according to a related art. As shown, the array substrate includes gate line **13** arranged in a transverse direction; data line **15** arranged in a longitudinal direction perpendicular to the gate line **13**; and a thin film transistor (TFT) "T" as a switching element formed near the crossing of the gate and data lines **13** and **15**. The TFT "T" has a gate electrode **31**, a source electrode **33** and a drain electrode **35**. The gate electrode **31** is extended from the gate line **13**, and the source electrode **33** is extended from the data line **15**. The drain electrode **35** is spaced apart from the source electrode **33**. The source and drain electrodes **33** and **35** respectively overlap both ends of the gate electrode **31**. The TFT "T" also has a semiconductor layer **32** that is made of amorphous silicon (a-Si:H) or poly-silicon.

Moreover, the array substrate further includes a pixel electrode **17** formed on a pixel region "P" that is defined by the gate and data lines **13** and **15**. The pixel electrode **17** is electrically connected with the drain electrode **35** through a drain contact hole **36**, and is usually made of a transparent conductive material such as indium tin oxide (ITO) and indium zinc oxide (IZO). A portion of the pixel electrode **17** overlaps a portion of the gate line **13** such that a storage capacitor "C" is comprised of the pixel electrode **17** and gate line **13** and the interposed dielectric layer (not show).

Still referring to FIG. **2**, the gate line **13** supplies scanning signals to the gate electrode **31** of the TFT "T" such that the switching element, i.e., the TFT, turns ON. The scanning signals transmitted to the gate line **13** then control the magnitude of the data signals transmitted from the data line **15** to the pixel electrode **17** via the TFT "T." The data signals of the pixel electrode **17** cause the polarization and re-arrangement of the liquid crystal molecules that are disposed over the pixel electrode **17**. When the scanning signals are not supplied to the gate line **13**, the TFT "T" is turned OFF. At this time, electric charges stored in the pixel are discharged through the TFT "T" and through the liquid crystals. In this discharge phenomenon, if the off resistance is larger or if the pixel area is smaller for improving the resolution, the electric charges stored in the pixel are more rapidly discharged.

In order to solve these problems, the storage capacitor "C" has a parallel connection with the pixel electrode **17** and compensates for electric discharges. Thus, the data signal is maintained in the pixel. At this time, the data signal, however, is affected by source-gate or drain-gate parasitic capacitance. This effect leads to pixel flickering, image retention and nonuniform display.

In general, the parasitic capacitance occurs between the source and gate electrodes **33** and **31** of the TFT "T" or between the drain and gate electrodes **35** and **31** of the TFT "T". The parasitic capacitance between the source and gate electrodes **33** and **31** is referred to as source-gate or gate-source parasitic capacitance (C_{gs} or C_{sg}). The parasitic capacitance between the drain and gate electrodes **35** and **31** is referred to as drain-gate or gate-drain parasitic capacitance (C_{dg} or C_{gd}). When the semiconductor layer **32** is fully saturated by the electric charges, the gate-drain parasitic capacitance C_{gd} is increased due to the fact that the electric charges stored in the pixel electrode **17** are transmitted to the drain electrode **35**. Again, this parasitic capacitance causes pixel flickering, the image retention, and gray scale nonuniformity. Thus, it is essentially required to decrease the gate-drain parasitic capacitance C_{gd}.

Still referring to FIG. **2**, the gate electrode **31** is protruded from the gate line **13** over the pixel region "P" near the

crossing of the gate and data lines **13** and **15**. The source and drain electrodes **33** and **35** overlap both ends of the gate electrode **31**. In this structure shown in FIG. **2**, the gate-drain parasitic capacitance C_{gd} is defined by an area in which the drain electrode **35** overlaps the gate electrode **31**. Moreover, misalignment often occurs between the gate and drain electrodes **31** and **35** when forming the co-planar source and drain electrodes **33** and **35** over both ends of the gate electrode **31** using a pattern process. Thus, the gate-drain parasitic capacitance C_{gd} varies owing to this misalignment between the gate and drain electrodes **31** and **35**. For example, if the width and length of the drain electrode **35** are respectively 30 μm and 5 μm, the ratio of the width and the length is 30 to 5. In this case, the overlapped ratio of the drain electrode **35** is usually determined to be 30 to 4, and thus the overlapped area between the drain and gate electrodes becomes 120 μm^2 (i.e., 30 μm×4 μm). However, if the drain electrode **35** horizontally further overlaps by 1 μm, the overlapped area between the gate and drain electrodes **31** and **35** is 150 μm^2 (i.e., 30 μm×5 μm). Further, if the drain electrode **35** horizontally less overlaps by 1 μm, the overlapped area between the gate and drain electrodes **31** and **35** is 90 μm^2. These means that a misalignment of 1 μm causes great variations of the gate-drain parasitic capacitance C_{gd} by 25%.

As described above, the parasitic capacitance fluctuates depending on the overlapped area, and the unstable parasitic capacitance affects the data signal transmitted from the data line to the pixel electrode through the TFT. Accordingly, the display characteristics of the liquid crystal display become irregular. As a result, the picture quality is deteriorated by these irregular display characteristics.

FIGS. **3** and **4** are schematic partial plan views illustrating the crossover point of the gate and data lines of an array substrate for the liquid crystal display device according to another related art. As shown, in contrast to the above-mentioned array substrate, a gate electrode **41** is formed in the gate line **47**. Namely, a portion of the gate line **47**, near the crossing of the gate and data lines **47** and **43**, is used as the gate electrode **41**. In order to form the TFT, a drain electrode **45** is formed over the gate line **47**. Thus, the gate-drain parasitic capacitance C_{gd} is determined by an area of the drain electrode **45**.

Referring to FIG. **3**, a portion of the data line **43**, in which the gate line **47** is overlapped, functions as a source electrode. However, although FIG. **4** is similar to FIG. **3**, a source electrode **46** of FIG. **4** is extended from the gate line **43** over the gate line **47**. As shown in FIG. **4**, the source electrode **46** has a U-shape in order to increase the width of the channel region between the drain electrode **45** and the source electrode **46**. Even though the structure of the drain electrode **45** causes parasitic capacitance, as shown in FIGS. **3** and **4**, the variation of the parasitic capacitance that is caused by the misalignment is smaller than the above-mentioned TFT depicted in FIG. **2**. However, whenever the drain electrode pattern becomes smaller and smaller in order to lower the parasitic capacitance, the process control for forming the drain electrode is difficult and at least an error of about 1 μm surely occurs in the overlapped area. And thus, a critical dimension loss occurs during the patterning process.

In order to overcome the above-mentioned problem, the drain electrode **45** is designed to have a sufficiently large dimension. Thus, the horizontal length "d" is enlarged. At this time, the gate-drain parasitic capacitance C_{gd}, however, is also enlarged.

Accordingly, as described before, due to not only the gate-drain parasitic capacitance but also the variation of that

parasitic capacitance, the pixel flickering and other image deteriorations occur in the liquid crystal display device.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to an array substrate of a liquid crystal display device that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

To overcome the problems described above, the present invention provides an array substrate that has a novel structure for decreasing the gate-drain parasitic capacitance.

Another object of the invention is to provide an array substrate that decreases an overlapped area between gate and drain electrodes.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims thereof as well as the appended drawings.

To achieve these and other objects and in accordance with the purpose of the present invention, as embodied and broadly described, an array substrate for use in a liquid crystal display device having a lower gate-drain parasitic capacitance includes a gate line arranged in a horizontal direction on a substrate; a data line arranged in a vertical direction perpendicular to the gate line over the substrate; and a thin film transistor formed near the crossing of the gate and data lines, the thin film transistor comprising a gate electrode that is a portion of the gate line near the crossing, wherein the gate electrode has an open portion in its central portion, a first insulation layer on the gate electrode, a semiconductor layer formed on the first insulation layer and over the gate electrode, a drain electrode formed on the semiconductor layer and over the gate electrode, the drain electrode corresponding to the open portion of the gate electrode, and a source electrode extended from the data line and formed in the same plane as the drain electrode, the source electrode surrounding the drain electrode and the open portion of the gate electrode along the steps of the semiconductor layer.

The array substrate further includes a second insulation layer formed over the thin film transistor, the second insulation layer having a drain contact hole that exposes a portion of the drain electrode; and a pixel electrode formed in a pixel region that is defined hy the gate and data lines, the pixel electrode contacting the drain electrode through the drain contact hole.

In one embodiment, the open portion of the gate electrode has an inverted "T"-shape and first and second open portions. The first open portion is formed in a horizontal direction parallel with the gate line and the second open portion is formed in a vertical direction perpendicular to the first open portion. The drain electrode also has an inverted "T"-shape and includes first and second electrode portions. The first electrode portion is arranged in a horizontal direction parallel with the gate line and corresponds to the first open portion of the gate electrode. And the second electrode portion is arranged in a vertical direction perpendicular to the first electrode portion and corresponds to the second open portion.

The open portion of the gate electrode can also be shaped like a rectangle.

Edges of the first electrode portion of the drain electrode overlap the gate electrode. Namely, two or three side edges of the first electrode portion overlap the gate electrode.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

In the drawings:

FIG. **1** shows the configuration of a typical TFT-LCD device;

FIG. **2** is a plan view illustrating one pixel of an array substrate for the liquid crystal display device according to a related art;

FIGS. **3** and **4** are schematic partial plan views illustrating the crossover point of the gate and data lines of an array substrate for the liquid crystal display device according to related arts;

FIG. **5** is a schematic partial view illustrating the crossover point of the gate and data lines of an array substrate according to a first embodiment;

FIGS. **6**A to **6**C are plan views illustrating a manufacturing process for the array substrate of FIG. **5**;

FIG. **7** is a schematic partial plan view illustrating the crossover point of the gate and data lines of an array substrate according to a second embodiment;

FIG. **8** is a schematic partial plan view illustrating the crossover point of the gate and data lines of an array substrate according to a third embodiment; and

FIG. **9** is a cross-sectional view taken along line IX—IX of FIG. **6**C and illustrates layer elements of the thin film transistor according to a principle of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to embodiments of the present invention, which are illustrated in the accompanying drawings.

FIG. **5** is a schematic partial plan view illustrating the crossover point of gate and data lines of an array substrate according to a first embodiment. As shown, the array substrate includes a gate line **113**, which is arranged in a horizontal direction, and a data line **125**, which is arranged in a vertical direction. The gate line **113** has a portion used for a gate electrode **115** near the crossing of the gate and data lines **113** and **125**. In the central portion of the gate line **113** used for gate electrode **115**, an inverted "T"-shaped opening **114** is formed. The source electrode **119** is extended from the data line **125**, and has a quadrilateral opening in its central portion. Thus, the source electrode **119** surrounds the inverted "T"-shaped opening in the gate line **113**. The drain electrode **117** is shaped like the inverted "T"-shape and positioned corresponding to the inverted "T"-shaped opening **114** of the gate electrode **115**. Moreover, the drain electrode **117** is divided into a first electrode portion **117***a* and a second electrode portion **117***b*. And thus, the source electrode **119** also surrounds the first electrode portion **117***a* of the drain electrode **117**. As shown in FIG. **5**, at the end of the second electrode portion **117***b* of the drain electrode **117**, a drain contact hole **221** is formed, and thus a pixel electrode **225** is electrically connected with the drain electrode **117** through this drain contact hole **221**.

Still referring to FIG. **5**, in order to decrease an overlapped area between the gate electrode **115** and the drain electrode **117**, the portion of the gate electrode **115** under the drain electrode **117** is etched such that the inverted "T"-shaped opening **114** is formed. In other words, the portion of the gate electrode **115** corresponding to the first electrode portion **117***a* of the drain electrode **117** is etched in a smaller area than the first electrode portion **117***a*. Thus, edges of the first electrode portion **117***a* of the drain electrode **117** overlap the gate electrode **115**. Moreover, a portion of the gate electrode **115** under the second electrode portion **117***b* is etched in a wider area than the second electrode portion **117***b* of the drain electrode **117**. Thus, the gate electrode **115** is not overlapped by this second electrode portion **117***b*.

Accordingly, as described above, since the edges of the first electrode portion **117***a* of the drain electrode **117** only overlap the gate electrode **115**, the gate-drain parasitic capacitance that depends on the overlapped area is minimized.

FIGS. **6**A to **6**C are plan views illustrating a manufacturing process for the array substrate of FIG. **5**, and FIG. **9** is a cross-sectional view taken along line IX—IX of FIG. **6**C.

Referring to FIGS. **6**A and FIG. **9**, a first metal layer is formed on a substrate **111** by depositing a metallic material selected from a group consisting of aluminum (Al), chrome (Cr), molybdenum (Mo), tungsten (W) and the like. After that, the first metal layer is patterned so as to form the gate line **113** in a horizontal direction, and an imaginary line **112** where the data line is formed in a later step is defined. At this time, near the crossover point of the gate line **113** and imaginary line **112**, a portion of the gate line **113** is etched so as to form the inverted "T"-shaped opening **114** and the gate electrode **115** is defined there around. The inverted "T"-shaped opening **114** is divided into a first opening portion **114***a* and a second opening portion **114***b*. The first opening portion **114***a* is horizontally disposed in parallel with the gate line **113** in the gate electrode **115**, and the second opening portion **114***b* is vertically elongated from a top edge to a center of the gate line **113** in the gate electrode **115**. Thereby, the gate electrode **115** includes the inverted "T"-shaped opening **114** having the first and second opening portion **114***a* and **114***b*.

Further, although not depicted in FIG. **6**A but shown in FIG. **9**, a first insulation layer **116** is formed on the substrate **111** and gate line **113** by depositing an inorganic material, such as silicon nitride (SiN_x) or silicon oxide (SiO_2), or an organic material, such as benzocyclobutene (BCB) or acryl.

Thereafter, an amorphous silicon layer and impurity-included-amorphous silicon layer are formed successively. The amorphous silicon layer and the impurity-included-amorphous silicon layer are patterned into an island-shaped layer so as to form a semiconductor layer **123**. As shown in FIG. **6**A, the semiconductor layer **123** is located over the inverted "T"-shaped opening **114** of the gate electrode **115** and is larger than the first opening portion **114***a*.

Referring to FIGS. **6**B and **9**, a second metal layer is formed on the entire surface of the substrate **111** including the gate line **113**, a first insulation layer **116** and the semiconductor layer **123**. The second metal layer is the same kind of material as the first metal layer. After that, the second metal layer is patterned so as to form the data line **125** in the area defined by the imaginary line **112** of FIG. **6**A. Thus, the data line **125** is perpendicular to the gate line **113** and, with the gate line **113** defines a pixel area "P." During this patterning process, the source electrode **119** extended from the data line **125** is simultaneously formed over the gate

electrode **115**. The shape of the source electrode **119** is a quadrilateral and has a quadrilateral opening therein such that the source electrode **119** surrounds the first opening portion **114***a* of the inverted "T"-shaped opening **114**. Also, the drain electrode **117** is simultaneously formed over the inverted "T"-shaped opening **114** in the same plane as the source electrode **119**.

Still referring to FIGS. **6**B and **9**, the drain electrode **117** is patterned into an inverted "T"-shape and corresponds to the inverted "T"-shaped opening **114** of the gate electrode **115**. Again, the drain electrode **117** is divided into the first electrode portion **117***a* and the second electrode portion **117***b*. The first electrode portion **117***a* overlaps the gate electrode **115** such that the edges of the first electrode portion **117***a* form a "U"-shaped overlapped area (depicted by oblique lines) with the gate electrode **115**. The second electrode portion **117***b* is vertically extended from the first electrode portion **117***a* over the pixel area "P," and does not overlaps the gate electrode **115** due to the fact that the second electrode portion **117***b* is narrower than the second opening portion **114***b* of FIG. **6**A. Moreover, the drain electrode **117** is spaced apart from the source electrode **119**, and the first electrode portion **117***a* of the drain electrode **117** is surrounded by the source electrode **119** along the steps of the semiconductor layer **123**.

Further, although not depicted in FIG. **6**B but depicted in FIG. **9**, a second insulation layer **118** is formed on the above-mentioned intermediates by depositing an inorganic material, such as silicon nitride (SiN_X) or silicon oxide (SiO_2), or an organic material, such as benzocyclobutene (BCB) or acryl. Next, the second insulation layer (not shown) is patterned in order to form a drain contact hole **221** at the end of the second electrode portion **117***b* of the drain electrode **117**.

Now, referring to FIG. **6**C, a transparent conductive material such as indium-tin-oxide (ITO) or indium-zinc-oxide (IZO) is deposited on the above-mentioned second insulation layer. After that, the transparent conductive material is patterned to form a pixel electrode **225** in the pixel region "P" (see FIG. **6**B). And thus, the pixel electrode **225** contacts the drain electrode **117** through the drain contact hole **221**.

As described hereinbefore, since only the edges of the fist electrode portion of the drain electrode overlaps the gate electrode, the gate-drain parasitic capacitance C_{gd} is reduced and minimized due to the smaller overlapped area. Moreover, referring to the enlarged view of the first electrode portion of the drain electrode as shown in FIG. **6**C, the compensation for any misalignment will be explained. When forming the drain electrode **117** over the inverted "T"-shaped opening **114** of the gate electrode **115**, the drain electrode **117** can be misaligned in a horizontal or vertical direction. If the left portion "A_1" of the overlapped area is decreased due to horizontal misalignment, the right portion "A_2" is increased. In this manner, if the bottom portion "B_1" of the overlapped area is decreased due to vertical misalignment, the top portion "B_2" is increased. Thus, the overlapped area between the drain electrode **117** and the gate electrode **115** is maintained uniformly even though misalignment occurs. Therefore, the variation of the gate-drain parasitic capacitance is reduced and minimized.

FIG. **7** is a schematic partial plan view illustrating the crossover point of the gate and data lines of an array substrate according to a second embodiment. As shown, the second embodiment is similar to the first embodiment depicted in FIG. **5** and the manufacturing process is the same as the first embodiment depicted in FIGS. **6**A to **6**C and in FIG. **9**. However, the gate line **113** has a rectangle-shaped opening **229** in a portion for the gate electrode **115**.

Referring to FIG. **7**, the source electrode **119** is extended from the data line and has a "U"-shape. The drain electrode **117** is formed into an inverted "T"-shape and located over the rectangle-shaped opening **229** of the gate electrode **115**. The drain electrode **117** is also surrounded by the source electrode **119** along the steps of the semiconductor layer **123**, as in the first embodiment. Moreover, edges of the drain electrode **117** overlap the gate electrode **115**, and thus the overlapped area is formed generally with a "U"-shape (depicted by oblique lines). As a result, the gate-drain parasitic capacitance C_{gd} is reduced and minimized as in the first embodiment.

Moreover, referring to the enlarged view of the drain electrode **117** of FIG. **7**, any misalignment occurring in the step of forming the drain electrode **117** is compensated. When forming the drain electrode **117** over the rectangle-shaped opening **229** of the gate electrode **115**, the drain electrode **117** can be misaligned in a horizontal or vertical direction. If the left portion "A_1" of the overlapped area is decreased due to horizontal misalignment, the right portion "A_2" is increased. In this manner, if the bottom portion "B_1" of the overlapped area is decreased due to vertical misalignment, the left and right portions "A_1" and "A_2" are increased. Thus, the overlapped area between the drain electrode **117** and the gate electrode **115** is maintained uniformly even though the misalignment occurs. Therefore, the variation of the gate-drain parasitic capacitance is lowered and minimized.

FIG. **8** is a schematic partial view illustrating the crossover point of the gate and data lines of an array substrate according to a third embodiment. As shown, the third embodiment is similar to the second embodiment and the manufacturing process is the same as the second embodiment. However, the overlapped area (depicted by oblique lines) is formed on both end sides of the drain electrode **117**.

As shown in FIG. **8**, the gate line **113** is arranged in a horizontal direction and the data line **125** is arranged in a vertical direction perpendicular to the gate line **113**. The source electrode **119** is extended from the data line **125** and has a "U"-shape. A rectangle-shaped opening is formed in a portion for the gate electrode **115** in the gate line **113**. Also, the drain electrode **117** is formed over the rectangle-shaped opening of the gate electrode **115**. Although the drain electrode **117** has an inverted "T"-shape, only both end sides of the drain electrode **117** overlap the gate electrode. Thus, the overlapped area (depicted in oblique lines) is reduced and minimized, and the gate-drain parasitic capacitance C_{gd} is also reduced and minimized.

Moreover, referring to the enlarged view of the drain electrode **117** as shown in FIG. **8**, any misalignment occurring in the step of forming the drain electrode **117** is compensated. When forming the drain electrode **117** over the rectangle-shaped open of the gate electrode **115**, the drain electrode **117** can be misaligned in a horizontal direction. If the left portion "A_1" of the overlapped area is decreased due to horizontal misalignment, the right portion "A_2" is increased. Thus, the overlapped area between the drain electrode **117** and the gate electrode **115** is maintained uniformly even though misalignment occurs. Therefore, the variation of the gate-drain parasitic capacitance is reduced and minimized.

As described hereinbefore, according to the principles of the present invention, a portion of the gate line is used as the

gate electrode. And a portion of the gate electrode is patterned so as to form a certain-shaped opening. Accordingly, there is a reduced overlap area between the gate electrode and the drain electrode. As a result, the gate-drain parasitic capacitance is reduced and minimized. Moreover, although misalignment occurs between the drain and gate electrodes, this misalignment is compensated according to the present invention. Thus, the variation of the gate-drain parasitic capacitance is prevented.

Therefore, flickering and the image retention are prevented so that a high resolution is achieved in the liquid crystal display device. And the picture quality is improved in the liquid crystal display device.

It will be apparent to those skilled in the art that various modifications and variation can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A method of forming a liquid crystal display device, comprising:

forming a gate line on a substrate, the gate line extending along a first direction and having an opening therein;

forming a first insulating layer on the gate line;

forming a semiconductor layer on the first insulating layer over at least a portion of the opening;

forming a data line on the insulating layer extending along a second direction substantially perpendicular to the first direction, a drain electrode on the semiconductor layer over at least a portion of the opening and, and a source electrode on the semiconductor layer extending from the data line and separated and spaced apart from the drain electrode.

2. The method of claim 1, further comprising forming a second insulation layer over the semiconductor layer and the source and drain electrodes, the second insulation layer having a drain contact hole that exposes a portion of the drain electrode.

3. The method of claim 2, further comprising forming a pixel electrode in a pixel region that is defined by an intersection of the gate and data lines, the pixel electrode contacting the drain electrode through the drain contact hole.

4. The method of claim 1, wherein the opening in the gate line is formed in substantially a "T" shape.

5. The method of claim 1, wherein the source electrode is formed to substantially surround the drain electrode.

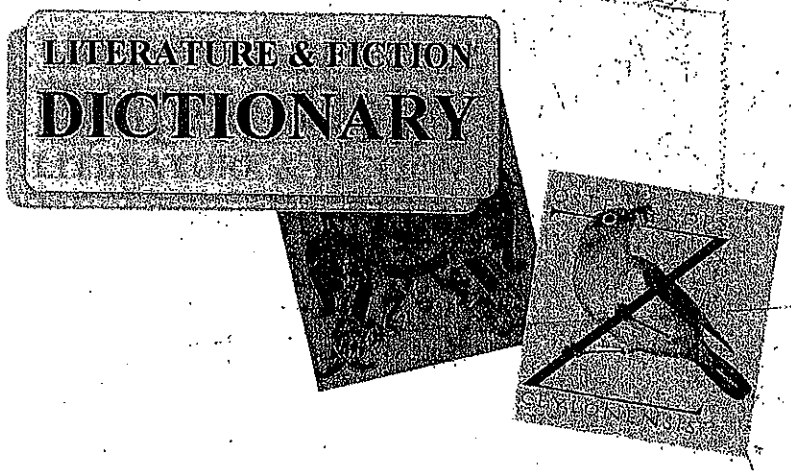
6. The method of claim 1, wherein the drain electrode is formed in substantially a "T" shape.

7. The method of claim 1, wherein forming the drain electrode comprises forming a first portion which overlaps the opening and a second portion which overlaps the gate line on at least two opposing sides of the opening.

* * * * *

EXHIBIT 10

The AMERICAN HERITAGE® dictionary of THE ENGLISH LANGUAGE



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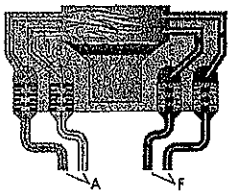


open-hearth
A. gas and air enter
B. pre-heated chamber
C. molten pig iron
D. hearth
E. heating chamber (cold)
F. gas and air exit

of its endpoints. **b.** Of or being a set such that at least one neighborhood of every point in the set is within the set. **c.** Of or being a set that is the complement of a closed set. **21.** *Sports* **a.** Having the forward foot further from the intended point of impact with the ball than the rear foot: *an open batting stance.* **b.** Held or swung with the top or outer edge of the striking face pointing slightly farther away from the objective than the lower or inner edge: *The club struck the ball with an open face, causing a slice.* ◆ *v.* **o•pened, o•pen•ing, o•pens** —*tr.* **1.** To release from a closed or fastened position. **2.** To remove obstructions from; clear. **3.** To make or force an opening in: *open an old wound.* **4a.** To form spaces or gaps between: *soldiers opening ranks.* **b.** To break the continuity of; make a gap in: *open a circuit.* **5a.** To remove the cover, cork, or lid from. **b.** To remove the wrapping from; undo. **6.** To unfold so that the inner parts are displayed; spread out: *open a newspaper.* **7a.** To get (something) going; initiate: *open a campaign.* **b.** To commence the operation of: *open a new business.* **8.** *Games* To begin (the action in a game of cards) by making the first bid, placing the first bet, or playing the first lead. **9.** To make available for use: *opened the area to commercial development; opened the computer file and retrieved some data.* **10.** To make more responsive or understanding. **11.** To reveal the secrets of; bare. **12.** *Sports* To modify (one's stance), as in baseball or golf, so that it is open. **13.** *Law* To recall (an order or judgment) for a reexamination of its merits. —*intr.* **1.** To become open: *The door opened slowly.* **2.** To draw apart; separate: *The wound opened under pressure.* **3.** To spread apart; unfold. **4.** To come into view; become revealed: *The plain opened before us.* **5.** To become receptive or understanding. **6a.** To begin; commence: *The meeting opened with a call to order.* **b.** To begin business or operation: *The store opens early on Saturday.* **7.** To be performed, shown, or made available to the public for the first time: *The play opens next week.* **8.** To be priced or listed at a specified amount when trading begins: *Shares opened high and fell sharply.* **9.** *Games* To make a bid, bet, or lead in starting a game of cards. **10.** To give access: *The room opens onto a terrace.* ◆ *n.* **1.** An unobstructed area of land or water. **2.** The outdoors: *camping in the open.* **3.** An undisguised or unconcealed state: *brought the problem out into the open.* **4.** A tournament or contest in which both professional and amateur players may participate. —***phrasal verb:*** **open up 1.** To spread out; unfold: *A green valley opened up before us.* **2a.** To begin operation: *The new store opens up next month.* **b.** To begin firing: *The artillery opened up at dawn.* **3.** *Informal* To speak freely and candidly: *At last the frightened witness opened up and told the truth.* **4.** To make an opening in by cutting: *The surgeon opened up the patient's chest.* **5.** To make available or accessible: *open up new markets.* **6.** *Informal* To accelerate. Used of a motor vehicle. —***idioms:*** **open fire** To begin firing on. **open (one's) eyes** To become aware of the truth of a situation. [Middle English, from Old English. See upo in Appendix I.] —**o′pen•ly** *adv.* —**o′pen•ness** *n.*

open admissions *pl.n. (used with a sing. or pl. verb)* A policy that permits enrollment of a student in a college or university without regard to academic qualifications. Also called *open enrollment.*

open adoption *n.* An adoption arrangement in which contact between the adoptive and biological parents is allowed or maintained.

o•pen-air (ō′pən-âr′) *adj.* Outdoor: *an open-air concert.*

◆ **o•pen-and-shut** (ō′pən-ən-shŭt′) *adj.* **1.** So obvious as to present no difficulties; easily settled or determined: *an open-and-shut case.* **2.** *New England & Southeastern New York* Alternating between sunshine and clouds; having variable skies.

open chain *n.* An arrangement of atoms that does not form a ring, as in silicon compounds and various carbon compounds, such as aliphatic hydrocarbons.

open city *n.* A city that is declared demilitarized during a war, thus gaining immunity from attack under international law.

open classroom *n.* **1.** A system of elementary education in which instruction and activities are informally structured, flexible, and individualized. **2.** A school or classroom in which this system is practiced.

open door *n.* **1.** Unhindered opportunity; free access. **2.** Admission to all on equal terms. **3.** A policy whereby a nation trades with all other nations on equal terms. —**o′pen-door′** (ō′pən-dôr′, -dōr′) *adj.*

o•pen-end (ō′pən-ĕnd′) *adj.* **1.** Having no definite limit of duration or amount: *an open-end contract.* **2.** Continually issuing new shares or buying back existing shares from shareholders: *an open-end mutual fund.* **3.** Permitting the borrowing of additional funds under existing terms: *an open-end mortgage.*

o•pen-end•ed (ō′pən-ĕn′dĭd) *adj.* **1.** Not restrained by definite limits, restrictions, or structure. **2.** Allowing for or adaptable to change. **3.** Inconclusive or indefinite: *"faintly bemused and uneasily open-ended about the whole horrible business"* (Charles Michener). **4.** Allowing for a spontaneous, unstructured response: *an open-ended question.* —**o′pen-end′ed•ly** *adv.* —**o′pen-end′ed•ness** *n.*

open-end investment company *n.* A mutual fund.

open-end wrench *n.* A wrench having fixed, open jaws on one or both ends.

open enrollment *n.* See **open admissions.**

o•pen•er (ō′pə-nər) *n.* **1.** One that opens, especially a device used to cut open cans or pry up bottle caps. **2.** *Games* **a.** The player who starts the betting in cards. **b. openers** Cards of sufficient value to enable the holder to open the betting. **3.** The first act in a theatrical variety show. **4.** *Sports* The first game in a series. —***idiom:*** **for openers** *Informal* To begin with: *"Out of 54 potential jurors, they knocked 20 off . . . just for openers"* (Joseph DiMona).

o•pen-eyed (ō′pən-īd′) *adj.* **1.** Having the eyes wide open, as in surprise. **2.** Watchful and alert.

o•pen-faced (ō′pən-fāst′) *adj.* **1.** Having a face that seems to exhibit honesty and sincerity. **2.** Having a side uncovered: *an open-faced sandwich.*

o•pen•hand•ed (ō′pən-hăn′dĭd) *adj.* Giving freely; generous. See synonyms at liberal. —**o′pen•hand′ed•ly** *adv.* —**o′pen•hand′ed•ness** *n.*

o•pen•heart•ed (ō′pən-här′tĭd) *adj.* **1.** Frank. **2.** Kindly. —**o′pen•heart′ed•ly** *adv.* —**o′pen•heart′ed•ness** *n.*

o•pen-hearth (ō′pən-härth′) *adj.* **1.** Designating or being a reverberatory furnace used in the production of high-quality steel. **2.** Of or relating to the steel produced in such a furnace.

o•pen-heart surgery (ō′pən-härt′) *n.* Surgery in which the thoracic cavity is opened to expose the heart and the blood is recirculated and oxygenated by a heart-lung machine.

open house *n.* **1.** A social event in which hospitality is extended to all. **2.** An occasion when a school or institution is open for visiting and observation by the public. **3a.** A period of time during which a house or apartment for sale or rent is held open for public viewing. **b.** A house or apartment open for such viewing.

o•pen•ing (ō′pə-nĭng) *n.* **1.** The act or an instance of becoming open or being made to open. **2.** An open space serving as a passage or gap. **3.** A breach or aperture. **4.** A clearing in the woods. **5.** The first part or stage, as of a book. **6.** The first performance: *the opening of a play.* **7.** A formal commencement of operation: *attended the opening of the new museum.* **8.** *Games* A specific pattern or series of beginning moves in certain games, especially chess. **9.** An opportunity affording a chance of success. See synonyms at **opportunity.** **10.** An unfilled job or position; a vacancy.

opening transaction *n.* **1.** The first transaction for a security during a trading day. **2.** An option order that establishes a new investment position or increases the size of an existing investment position.

open interval *n.* A set of numbers consisting of all the numbers between a pair of given numbers but not including the endpoints.

open letter *n.* A published letter on a subject of general interest, addressed to a person but intended for general readership.

open loop *n. Engineering* A control system that does not have a feedback loop and thus is not self-correcting.

open market *n.* A freely competitive market operating without restrictions.

open marriage *n.* A marriage in which the partners agree that each is free to engage in extramarital relationships.

o•pen-mind•ed (ō′pən-mīn′dĭd) *adj.* Having or showing receptiveness to new and different ideas or the opinions of others. See synonyms at **broad-minded.** —**o′pen-mind′ed•ly** *adv.* —**o′pen-mind′ed•ness** *n.*

o•pen-mouthed (ō′pən-mouthd′, -moutht′) *adj.* **1.** Having the mouth open. **2.** Gaping in astonishment or wonder. **3.** Loudly insistent. —**o′pen-mouth′ed•ly** *adv.* —**o′pen-mouth′ed•ness** *n.*

o•pen-pol•li•nat•ed (ō′pən-pŏl′ə-nā′tĭd) *adj.* Pollinated without human intervention, as by the wind or insects.

open season *n.* **1.** The period during which it is legal to hunt or catch game or fish. **2.** *Informal* A time of unrestrained harassment, criticism, or attack: *"By 1950 it was open season on Communists and their fellow travelers"* (Boston).

open secret *n.* Something supposedly secret but in fact generally known.

open sentence *n. Mathematics* An expression that contains at least one unknown quantity and becomes true or false when a test value is substituted for the unknown.

open sesame *n.* A simple, trusty means of attaining a goal. [From the magical formula *Open Sesame* used by Ali Baba in the *Arabian Nights* to open the door of the robbers' cave.]

open shop *n.* A business or factory in which workers are employed without regard to union membership.

o•pen-source (ō′pən-sôrs′, -sōrs′) *adj.* Of or relating to source code that is available to the public: *an open-source operating system.*

open stock *n.* Merchandise kept in stock so as to enable customers to replace or supplement articles, such as dishes, purchased in sets.

open universe *n.* A model of the universe in which there is insufficient matter, and thus insufficient gravitational force, to halt the expansion initiated by the big bang.

o•pen•work (ō′pən-wûrk′) *n.* Ornamental or structural work, as of embroidery or metal, containing numerous openings, usually in set patterns.

op•er•a[1] (ŏp′ər-ə, ŏp′rə) *n.* **1.** A theatrical presentation in which a dramatic performance is set to music. **2.** The score of such a work. **3.** A theater designed primarily for operas. [Italian, work, opera, from Latin, work, service. See op- in Appendix I.]

o•pe•ra[2] (ō′pər-ə, ŏp′ər-ə) *n.* A plural of **opus.**

op•er•a•ble (ŏp′ər-ə-bəl, ŏp′rə-) *adj.* **1.** Being such that use or operation is possible: *an operable machine.* **2.** Possible to put into practice; practicable: *an operable plan.* **3.** Treatable by surgical operation with a reasonable degree of safety and chance of success: *an operable cancer.* —**op′er•a•bil′i•ty** *n.* —**op′er•a•bly** *adv.*

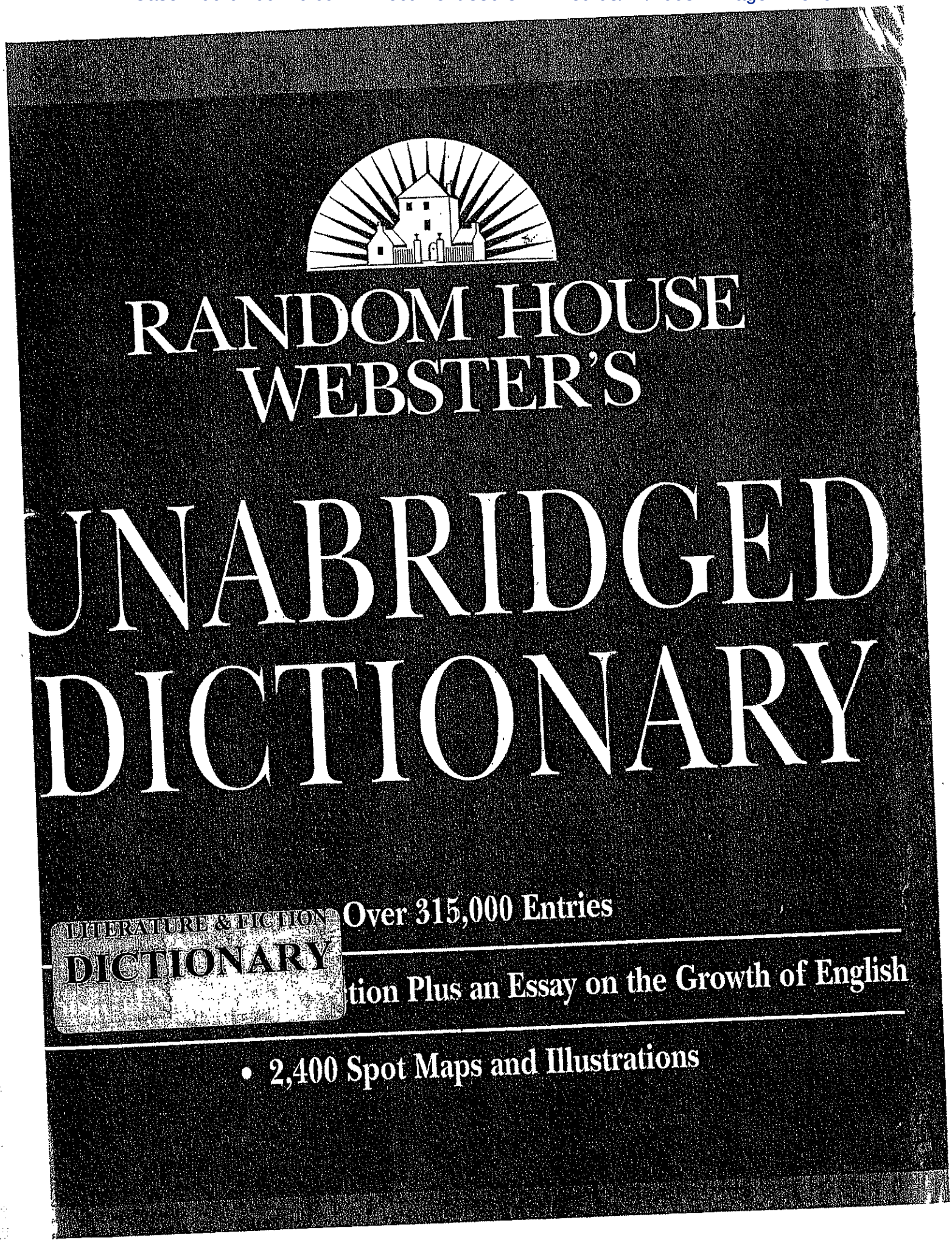
o•pé•ra bouffe (ŏp′ər-ə bōōf′, ŏp′rə, ō-pā-rä bōōf′) *n.* A comic, often farcical opera. [French, from Italian *opera buffa.* See OPERA BUFFA.]

o•pe•ra buf•fa (ŏp′ər-ə bōō′fə, ŏp′rə, ō′pĕ-rä bōō′fä) *n.* An Italian comic opera of the 18th century. [Italian : *opera,* opera + *buffa,* feminine of *buffo,* comic.]

o•pé•ra co•mique (ŏp′ər-ə kō-mēk′, ŏp′rə, ō-pā-rä kô-mēk′) *n.* A French comic opera. [French : *opéra,* opera + *comique,* comic.]

op•er•a glass (ŏp′ər-ə, ŏp′rə) *n.* A pair of small, low-powered bin-

EXHIBIT 11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prod′igal son′, a figure in a parable of Jesus (Luke 15:11–32); a wayward son who squanders his inheritance but returns home to find that his father forgives him. [1545–55]

pro·di·gious (prə dij′əs), *adj.* **1.** extraordinary in size, amount, extent, degree, force, etc.: *a prodigious research grant.* **2.** wonderful or marvelous: *a prodigious feat.* **3.** abnormal; monstrous. **4.** *Obs.* ominous. [1545–55; < L *prōdigiōsus* marvelous. See PRODIGY, -OUS] —**pro·di′gious·ly**, *adv.* —**pro·di′gious·ness**, *n.*
—**Syn. 1.** enormous, immense, huge, gigantic, tremendous. **2.** amazing, stupendous, astounding, wondrous, miraculous. —**Ant. 1.** tiny. **2.** ordinary.

prod·i·gy (prod′i jē), *n., pl.* **-gies. 1.** a person, esp. a child or young person, having extraordinary talent or ability: *a musical prodigy.* **2.** a marvelous example (usually fol. by *of*). **3.** something wonderful or marvelous; a wonder. **4.** something abnormal or monstrous. **5.** *Archaic.* something extraordinary regarded as of prophetic significance. [1425–75; late ME *prodige* < L *prōdigium* prophetic sign]

pro·do·mos (prō dō′mos), *n., pl.* **-moi** (-moi). *Archit.* an open vestibule, as a pronaos. [< Gk *pródomos* lit., before-house, equiv. to *pro-* PRO-[2] + *dómos* house (see DOME)]

pro·drome (prō′drōm), *n. Pathol.* a premonitory symptom. [1635–45; < F < NL *prodromus*, n. use of Gk *pródromos* running before. See PRO-[2], -DROME] —**pro·dro·mal** (prō drō′məl, prə drō′-), *adj.*

pro·drug (prō′drug′), *n. Pharm.* an inactive substance that is converted to a drug within the body by the action of enzymes or other chemicals. [PRO-[1] + DRUG]

pro·duce (*v.* prə dōōs′, -dyōōs′; *n.* prod′ōōs, -yōōs, prō′dōōs, -dyōōs), *v.*, **-duced, -duc·ing**, *n.* —*v.t.* **1.** to bring into existence; give rise to; cause: *to produce steam.* **2.** to bring into existence by intellectual or creative ability: *to produce a great painting.* **3.** to make or manufacture: *to produce automobiles for export.* **4.** to bring forth; give birth to; bear: *to produce a litter of puppies.* **5.** to provide, furnish, or supply; yield: *a mine producing silver.* **6.** *Finance.* to cause to accrue: *stocks producing unexpected dividends.* **7.** to bring forward; present to view or notice; exhibit: *to produce one's credentials.* **8.** to bring (a play, movie, opera, etc.) before the public. **9.** to extend or prolong, as a line. —*v.i.* **10.** to create, bring forth, or yield offspring, products, etc.: *Their mines are closed because they no longer produce.* **11.** *Econ.* to create economic value; bring crops, goods, etc., to a point at which they will command a price. —*n.* **prod·uce 12.** something that is produced; yield; product. **13.** agricultural products collectively, esp. vegetables and fruits. **14.** offspring, esp. of a female animal: *the produce of a mare.* [1375–1425; late ME *producen* < L *prōdūcere* to lead or bring forward, extend, prolong, produce, equiv. to *prō-* PRO-[1] + *dūcere* to lead] —**pro·duc′i·ble, pro·duce′a·ble, pro·duct′i·ble**, *adj.* —**pro·duc′i·bil′i·ty, pro·duct′i·bil′i·ty** (prə duk′tə bil′i tē), **pro·duc′i·ble·ness, pro·duce′a·ble·ness**, *n.*
—**Syn. 1.** generate, create. **5.** afford. **7.** show. **13.** See **crop.** —**Ant. 1.** destroy, ruin. **7.** conceal.

pro·duc·er (prə dōō′sər, -dyōō′-), *n.* **1.** a person who produces. **2.** *Econ.* a person who creates economic value, or produces goods and services. **3.** a person responsible for the financial and administrative aspects of a stage, film, television, or radio production; the person who exercises general supervision of a production and is responsible chiefly for raising money, hiring technicians and artists, etc., required to stage a play, make a motion picture, or the like. Cf. **director** (def. 3). **4.** *Theat. Brit.* (formerly) a director of theatrical productions; stage director. **5.** an apparatus for making producer gas. **6.** *Ecol.* an organism, as a plant, that is able to produce its own food from inorganic substances. [1605–15; PRODUCE + -ER[1]]

prod′uce race′, *Horse Racing.* a race for the offspring of parents identified or characterized at the time of nomination.

produc′er gas′, a gas composed of carbon monoxide, hydrogen, and nitrogen, obtained by passing air and steam through incandescent coke: used as an industrial fuel, in certain gas engines, and in the manufacture of ammonia. Also called **air gas.** [1890–95]

produc′er goods′, *Econ.* goods, as machinery, raw materials, etc., that are used in the process of creating consumer goods. [1950–55]

prod·uct (prod′əkt, -ukt), *n.* **1.** a thing produced by labor: *products of farm and factory; the product of his thought.* **2.** a person or thing produced by or resulting from a process, as a natural, social, or historical one; result: *He is a product of his time.* **3.** the totality of goods or services that a company makes available; output: *a decrease in product during the past year.* **4.** *Chem.* a substance obtained from another substance through chemical change. **5.** *Math.* **a.** the result obtained by multiplying two or more quantities together. **b.** intersection (def. 3a). [1400–50; late ME < L *prōductum* (thing) produced, neut. of ptp. of *prōdūcere* to PRODUCE]

pro·duc·tile (prə duk′til), *adj.* capable of being lengthened out; extensile. [1720–30; < LL *prōductilis* prolongable, equiv. to L *prōduct(us)* (ptp. of *prōdūcere* to extend, PRODUCE) + *-ilis* -ILE]

pro·duc·tion (prə duk′shən), *n.* **1.** the act of producing; creation; manufacture. **2.** something that is produced; a product. **3.** *Econ.* the creation of value; the producing of articles having exchange value. **4.** the total amount produced: *Production is up this month.* **5.** a work of literature or art. **6.** the act of presenting for display; presentation; exhibition: *the production of evidence in support of the case.* **7.** *Informal.* an unnecessarily or exaggeratedly complicated situation or activity: *That child makes a production out of going to bed.* **8.** the organization and presentation of a dramatic entertainment. **9.** the entertainment itself: *an expensive production.* —*adj.* **10.** regularly manufactured; not custom-made, specially produced, or experimental: *a production model.* [1400–50; late ME < L *prōductiōn-* (s. of *prōductiō*) a lengthening. See PRODUCT, -ION] —**pro·duc′tion·al**, *adj.*
—**Syn. 6.** introduction, appearance, display, materialization.

produc′tion con′trol′, the planning and supervision of manufacturing activities to ensure that goods will be produced on time at the lowest possible cost. [1925–30]

produc′tion line′, an arrangement of machines or sequence of operations involved with a single manufacturing operation or production process. Cf. **assembly line, line[1]** (def. 29). [1930–35]

produc′tion num′ber, *Theat.* a specialty number or routine, usually performed by the entire cast consisting of musicians, singers, dancers, stars, etc., of a musical comedy, vaudeville show, or the like. [1935–40]

pro·duc·tive (prə duk′tiv), *adj.* **1.** having the power of producing; generative; creative: *a productive effort.* **2.** producing readily or abundantly; fertile: *a productive vineyard.* **3.** causing; bringing about (usually fol. by *of*): *conditions productive of crime and sin.* **4.** *Econ.* producing or tending to produce goods and services having exchange value. **5.** *Gram.* (of derivational affixes or patterns) readily used in forming new words, as the suffix *-ness.* **6.** (in language learning) of or pertaining to the language skills of speaking and writing (opposed to *receptive*). [1605–15; < ML *productivus*. See PRODUCT, -IVE] —**pro·duc′tive·ly**, *adv.* —**pro·duc′tive·ness**, *n.* —**pro·duc·tiv·i·ty** (prō′duk tiv′i tē), *n.*
—**Syn. 2.** fecund. PRODUCTIVE, FERTILE, FRUITFUL, PROLIFIC apply to the generative aspect of something. PRODUCTIVE refers to a generative source of continuing activity: *productive soil; a productive influence.* FERTILE applies to that in which seeds, literal or figurative, take root: *fertile soil; a fertile imagination.* FRUITFUL refers to that which has already produced and is capable of further production: *fruitful soil, discovery, theory.* PROLIFIC means highly productive: *a prolific farm, writer.*

prod′uct liabil′ity, the responsibility of a manufacturer for injury or loss caused by its product. [1975–80]

prod′uct line′, **1.** all of the products carried by a manufacturer, wholesaler, or retailer. **2.** a group of products of the same manufacturer having similar or related characteristics and intended for similar or related markets. [1965–70]

prod′uct mark′, a trademark used on only one product. Cf. **house mark, line mark.**

pro·em (prō′em), *n.* an introductory discourse; introduction; preface; preamble. [1350–1400; < L *prooemium* < Gk *prooímion* prelude (*pro-* PRO-[2] + *oím(ē)* song + *-ion* dim. suffix); r. ME *proheme* < MF < L, as above] —**pro·e·mi·al** (prō ē′mē əl, -em′ē-), *adj.*

pro·en·zyme (prō en′zīm), *n. Biochem.* any of a group of proteins that are converted to active enzymes by partial breakdown, as by the action of an acid or other enzyme. Also called **zymogen.** [1895–1900; PRO-[1] + ENZYME]

pro·es·trus (prō es′trəs), *n.* the period immediately preceding estrus. Also, **pro·oestrus.** [1920–25; PRO-[1] + ESTRUS]

prof (prof), *n. Informal.* professor. [1830–40, *Amer.*; by shortening]

Prof., Professor.

pro-fam·i·ly (prō fam′ə lē, -fam′lē), *adj.* favoring or supporting laws against abortion; antiabortion; pro-life. Also, **pro-fam′i·ly.** [1980–85; PRO-[1] + FAMILY]

prof·a·na·tion (prof′ə nā′shən), *n.* the act of profaning; desecration; defilement; debasement. [1545–55; < LL *profānātiōn-* (s. of *profānātiō*) desecration, equiv. to L *profānāt(us)* (ptp. of *profānāre* to PROFANE) + *-iōn-* -ION; r. *prophanation* < MF < ML *prophānātiō*, for LL *profānātiō*, as above]
—**Syn.** sacrilege, blasphemy.

pro·fan·a·to·ry (prə fan′ə tôr′ē, -tōr′ē, prō-), *adj.* tending to desecrate; profaning. [1850–55; PROFANA-T(ION) + -ORY[1]]

pro·fane (prə fān′, prō-), *adj.*, *v.*, **-faned, -fan·ing.** —*adj.* **1.** characterized by irreverence or contempt for God or sacred principles or things; irreligious. **2.** not devoted to holy or religious purposes; unconsecrated; secular (opposed to *sacred*). **3.** unholy; heathen; pagan: *profane rites.* **4.** not initiated into religious rites or mysteries, as persons. **5.** common or vulgar. —*v.t.* **6.** to misuse (anything that should be held in reverence or respect); defile; debase; employ basely or unworthily. **7.** to treat (anything sacred) with irreverence or contempt; violate the sanctity of: *to profane a shrine.* [1350–1400; (adj.) < L *profānus* lit., before (outside of) the temple; r. ME *prophane* < ML *prophānus* desecrated (see PRO-[1], FANE); (v.) < L *profānāre*, deriv. of *profānus*; r. ME *profanen* < ML *prophānāre* to desecrate] —**pro·fane′ly**, *adv.* —**pro·fane′ness**, *n.* —**pro·fan′er**, *n.*
—**Syn. 1.** blasphemous, sacrilegious, impious, ungodly. **2.** temporal. **3.** unhallowed. **5.** low, mean, base. **7.** desecrate. —**Ant. 1.** sacred. **2.** spiritual. **3.** holy.

pro·fan·i·ty (prə fan′i tē, prō-), *n., pl.* **-ties** for 2. **1.** the quality of being profane; irreverence; conduct or language; a profane act or utterance. [1525–35; < LL *profānitās*. See PROFANE, -ITY]
—**Syn. 1, 2.** blasphemy, sacrilege. **2.** swearing, profanation; curse.

Prof. Eng., Professional Engineer.

pro·fert (prō′fərt), *n. Law.* an exhibition of a document or paper in open court. [1710–20; < L: lit., he brought forward]

pro·fess (prə fes′), *v.t.* **1.** to lay claim to; claim openly or ostensibly; pretend to: *He professed extreme regret.* **2.** to declare openly; announce or affirm; avow or acknowledge: *to profess one's satisfaction.* **3.** to affirm faith in or allegiance to (a religion, God, etc.). **4.** to declare oneself skilled or expert in; claim to have knowledge of (a thing) one's profession or business. **5.** to teach as professor: *She professes comparative literature.* **6.** to receive or admit into a religious order. —*v.i.* **7.** to make profession, avowal, or declaration. **8.** to take the vows of a religious order. [1400–50; late ME; back formation from PROFESSED]
—**Syn. 1.** claim, allege, purport, avow.

pro·fessed (prə fest′), *adj.* **1.** avowed; acknowledged. **2.** professing to be qualified; professional, rather than amateur. **3.** having taken the vows of, or been received into, a religious order. **4.** alleged; pretended. [1400–50; ME (in religious sense) < ML *professus(us)* (special use of L *professus*, ptp. of *profitērī* to declare publicly, equiv. to *pro-* PRO-[1] + *-fes-*, comb. form of *fatērī* to acknowledge + *-tus* ptp. suffix, with *tt* > *ss*) + *-ED*[2]]

pro·fess·ed·ly (prə fes′id lē), *adv.* **1.** allegedly; pretendedly: *He is only professedly poor.* **2.** avowedly; by open declaration: *She is professedly guilty of the crime.* [1560–70; PROFESSED + -LY]

pro·fes·sion (prə fesh′ən), *n.* **1.** a vocation requiring knowledge of some department of learning or science: *the profession of teaching.* Cf. **learned profession.** **2.** any vocation or business. **3.** the body of persons engaged in an occupation or calling: *to be respected in the medical profession.* **4.** the act of professing; avowal; declaration, whether true or false: *professions of devotion.* **5.** the declaration of belief in or acceptance of a religion or a faith: *the profession of Christianity.* **6.** the religion or faith professed. **7.** the declaration made in entering into membership of a church or religious order. [1175–1225; ME < ML *professiōn-* (s. of *professiō*) taking of the vows of a religious order. See PROFESS, -ION] —**pro·fes′sion·less**, *n.*
—**Syn. 1.** calling, employment. See **occupation.** **4.** asseveration, assertion, protestation.

pro·fes·sion·al (prə fesh′ə nl), *adj.* **1.** following an occupation as a means of livelihood or for gain: *a professional builder.* **2.** of, pertaining to, or connected with a profession: *professional studies.* **3.** appropriate to a profession: *professional objectivity.* **4.** engaged in one of the learned professions: *A lawyer is a professional person.* **5.** following as a business an occupation ordinarily engaged in as a pastime: *a professional golfer.* **6.** making a business or constant practice of something not properly to be regarded as a business: *"A salesman," he said, "is a professional optimist."* **7.** undertaken or engaged in as a means of livelihood or for gain: *professional baseball.* **8.** of or for a professional person or his or her place of business or work: *a professional apartment.* **9.** done by a professional: *professional equipment.* **10.** a person who belongs to one of the professions, esp. one of the learned professions. **11.** a person who earns a living in a specified occupation frequently engaged in by amateurs: *a golf professional.* **12.** an expert player, as of golf or tennis, serving as a teacher, consultant, performer, or contestant; pro. **13.** a person who is expert at his or her work: *You can tell by her comments that this editor is a real professional.* [1740–50; PROFESSION + -AL[1]] —**pro·fes′sion·al·ly**, *adv.*

profes′sional corpora′tion, a corporation formed by one or more licensed practitioners, esp. medical, legal, to operate their practices on a corporate basis. *Abbr.:* PC, P.C. [1965–70]

pro·fes·sion·al·ism (prə fesh′ə nl iz′əm), *n.* **1.** professional character, spirit, or methods. **2.** the skill, practice, or methods of a professional, as distinguished from an amateur. [1855–60; PROFESSIONAL + -ISM]

pro·fes·sion·al·ize (prə fesh′ə nl īz′), *v.*, **-ized, -iz·ing.** —*v.t.* **1.** to give a professional character or standing to; make into or establish as a profession: *to professionalize social work.* **2.** to become professional. Also, *esp. Brit.*, **pro·fes′sion·al·ise′.** [1855–60; PROFESSIONAL + -IZE] —**pro·fes′sion·al·i·za′tion**, *n.* —**pro·fes′sion·al·ist**, *n.* —**pro·fes′sion·al·iz′er**, *n.*

Profes′sional Stand′ards Review′ Organization, a group of physicians and sometimes other health-care professionals that monitors the quality and cost of medical services in a particular region of a community. *Abbr.:* PSRO

pro·fes·sor (prə fes′ər), *n.* **1.** a teacher of the highest academic rank in a college or university, who has been awarded the title *Professor* in a particular branch of learning; a full professor: *a professor of Spanish literature.* **2.** any teacher who has the rank of professor. **3.** an associate professor, or assistant professor. **4.** an instructor in some art or skilled sport: *a professor of singing; a professor of boxing.* **5.** a person who professes his or her sentiments, beliefs, etc. [1350–1400; < ML *professor* one who has taken the vows of a religious order, L; a public lecturer, equiv. to *profes-* (comb. form of *fatērī* to acknowledge, declare) + *-tor* -TOR, with *tt* > *ss*] —**pro·fes′so·ri·al** (prō′fə sôr′ē əl, -sōr′-, prof′ə-), *adj.* —**pro·fes′so·ri·al·ly**, *adv.* —**pro′fes·so′ri·al·ism**, *n.*

CONCISE ETYMOLOGY KEY: <, descended or borrowed from; >, whence; b., blend of, blended; c., cognate with; cf., compare; deriv., derivative; equiv., equivalent; imit., imitative; obl., oblique; r., replacing; s., stem; sp., spelling, spelled; resp., respelling, respelled; trans., translation; ?, origin unknown; *, unattested; ‡, probably earlier than. See the full key inside the front cover.

pro·boy′cott, *adj.*
pro′-Bra·zil′ian, *adj., n.*
pro-Brit′ish, *adj.*
pro-Bud′dhist, *n., adj.*
pro-budg′et-ing, *adj.*
pro′-Bul·gar′i·an, *adj., n.*
pro-Bur′man, *adj.*
pro·bus′ness, *adj.*
pro′-Cam·bo′di·a, *adj.*
pro′-Cam·bo′di·an, *adj., n.*
pro′-Came·roon′, *adj., n.*
pro′-Ca·na′di·an, *adj., n.*
pro·cap′i·tal·ism, *n.*
pro·cap′i·tal·ist, *n., adj.*
pro-Cath′o·lic, *adj., n.*
pro′-Ca·thol′i·cism, *n.*
pro·cen′sor·ship′, *adj.*
pro·cen′sure, *adj.*
pro′cen·tral·i·za′tion, *n.*
adj.
pro′ce·phal′ic, *adj.*
pro′-Cey·lon′, *adj.*
pro′-Cey·lo·nese′, *adj., n., pl.* **-nese.**
pro·char′i·ty, *adj.*
pro-Chil′e·an, *adj., n.*
pro′-Chi·nese′, *adj., n., pl.* **-nese.**
pro·church′, *adj.*
pro·cit′y, *adj.*

MF, as above] —**sur·pris·ed·ly** (sər·prī′zid lē, -prīzd′-, sə-), *adv.* —**sur·pris′er,** *n.*

—**Syn. 1.** SURPRISE, ASTONISH, AMAZE, ASTOUND mean to strike with wonder because of unexpectedness, strangeness, unusualness, etc. To SURPRISE is to take unawares or to affect with wonder: *surprised at receiving a telegram.* To ASTONISH is to strike with wonder by something unlooked for, startling, or seemingly inexplicable: *astonished at someone's behavior.* To AMAZE is to astonish so greatly as to disconcert or bewilder: *amazed at such an evidence of stupidity.* To ASTOUND is to so overwhelm with surprise that one is unable to think or act: *astounded by the news.*

surprise′ par′ty, 1. a party or celebration planned for someone as a surprise. 2. something that surprises someone. [1835–45]

Surprise′ Sym′phony, the Symphony No. 94 in G major (1791) by Franz Josef Haydn.

sur·pris·ing (sər prī′zing, sə-), *adj.* 1. causing surprise, wonder, or astonishment. 2. unexpected. [1670–80; SURPRISE + -ING²] —**sur·pris′ing·ly,** *adv.*

sur·ra (sŏŏr′ə), *n. Vet. Pathol.* an often fatal infectious disease of horses, camels, elephants, and dogs caused by a blood-infecting protozoan parasite, *Trypanosoma evansi,* transmitted by the bite of horseflies, characterized by fever, anemia, and emaciation. [1885–90; < Marathi *sūra* heavy breathing sound]

Sur·ratt (sə rat′), *n.* **Mary Eugenia (Jenkins),** 1820–65, alleged conspirator: boardinghouse owner hanged as accomplice in assassination of President Lincoln.

sur·re·al (sə rē′əl, -rēl′), *adj.* 1. of, pertaining to, or characteristic of surrealism; surrealistic. 2. having the disorienting, hallucinatory quality of a dream; unreal; fantastic: *surreal complexities of the bureaucracy.* [1935–40; back formation from SURREALISM; see SUR-¹, REAL¹] —**sur·re′al·ly,** *adv.* —**sur·re·al·i·ty** (sə rē al′i·tē), *n.*

sur·re·al·ism (sə rē′ə liz′əm), *n.* (*sometimes cap.*) a style of art and literature developed principally in the 20th century, stressing the subconscious or nonrational significance of imagery arrived at by automatism or the exploitation of chance effects, unexpected juxtapositions, etc. [1920–25; < F *surréalisme.* See SUR-¹, REALISM]

—**sur·re′al·ist,** *n., adj.*

sur·re·al·is·tic (sə rē′ə lis′tik), *adj.* 1. of, pertaining to, or characteristic of surrealism; surreal. 2. having features typical or reminiscent of those depicted in surrealistic painting or drawing: *the moon's surrealistic landscape.* [1925–30; SURREALIST + -IC] —**sur·re′al·is′ti·cal·ly,** *adv.*

sur·re·but·tal (sŭr′ri but′l), *n. Law.* the giving of evidence to meet a defendant's rebuttal. [1885–90; SUR-¹ + REBUTTAL]

sur·re·but·ter (sŭr′ri but′ər), *n. Law.* a plaintiff's reply to a defendant's rebutter. [1595–1605; SUR-¹ + REBUTTER]

sur·re·join·der (sŭr′ri join′dər), *n. Law.* a plaintiff's reply to a defendant's rejoinder. [1595–45; SUR-¹ + REJOINDER]

sur·ren·der (sə ren′dər), *v.t.* 1. to yield (something) to the possession or power of another; deliver up possession of on demand or under duress: *to surrender the fort to the enemy; to surrender the stolen goods to the police.* 2. to give (oneself) up, as to the police. 3. to give (oneself) up to some influence, course, emotion, etc.: *He surrendered himself to a life of hardship.* 4. to give up, abandon, or relinquish (comfort, hope, etc.). 5. to yield or resign (an office, privilege, etc.) in favor of another. —*v.i.* 6. to give oneself up, as into the power of another; submit or yield. —*n.* 7. the act or an instance of surrendering. 8. *Insurance.* the voluntary abandonment of a life-insurance policy by the owner for any of its nonforfeiture values. 9. the deed by which a legal surrendering is made. [1425–75; (v.) late ME *surrendren* < AF *surrender,* OF *surrendre* to give up, equiv. to *sur-* SUR-¹ + *rendre* to RENDER; (n.) < AF; OF *surrendre,* n. use of the inf.] —**sur·ren′der·er,** *n.*

—**Syn. 1.** See **yield. 4.** renounce. **5.** waive, cede, abandon, forgo. **6.** capitulate. **7.** capitulation, relinquishment.

surren′der val′ue, *Insurance.* See **cash value.** [1875–80]

sur·rep·ti·tious (sŭr′ep tish′əs), *adj.* 1. obtained, done, made, etc., by stealth; secret or unauthorized; clandestine: *a surreptitious glance.* 2. acting in a stealthy way. 3. obtained by subreption; subreptitious. [1400–50; late ME < L *surrepticius* stolen, clandestine, equiv. to *surrept(us),* ptp. of *surripere* to steal, (*sur-* SUR-² + *rep-,* comb. form of *rapere* to snatch, RAPE¹ + *-tus* ptp. suffix) + *-icius* -ITIOUS] —**sur′rep·ti′tious·ly,** *adv.* —**sur′rep·ti′tious·ness,** *n.*

sur·rey (sûr′ē, sur′ē), *n., pl.* **-reys.** a light, four-wheeled, two-seated carriage, with or without a top, for four persons. [1890–95; after SURREY, England]

CONCISE ETYMOLOGY KEY: <, descended or borrowed from; >, whence; b., blend of, blended; c., cognate with; cf., compare; deriv., derivative; equiv., equivalent; imit., imitative; obl., oblique; r., replacing; s., stem; sp., spelling, spelled; resp., respelling, respelled; trans., translation; ?, origin unknown; *, unattested; ‡, probably earlier than. See the full key inside the front cover.

Sur·rey (sûr′ē, sur′ē), *n.* **1. Earl of** (*Henry Howard*), 1517?–47, English poet. **2.** a county in SE England, bordering S London. 1,000,700; 648 sq. mi. (1680 sq. km).

sur·ro·gate (*n., adj.* sûr′ə gāt′, -git, sur′-; *v.* sûr′ə gāt′, sur′-), *n., adj., v.,* **-gat·ed, -gat·ing.** —*n.* **1.** a person appointed to act for another; deputy. **2.** (in some states) a judicial officer having jurisdiction over the probate of wills, the administration of estates, etc. **3.** the deputy of an ecclesiastical judge, esp. of a bishop or a bishop's chancellor. **4.** a substitute. **5.** a surrogate mother. —*adj.* **6.** regarded or acting as a surrogate: *a surrogate father.* **7.** involving or indicating the use of a surrogate mother to conceive or carry an embryo: *surrogate parenting.* —*v.t.* **8.** to put into the place of another as a successor, substitute, or deputy; substitute for another. **9.** to subrogate. [1525–35; < L *surrogātus,* assimilated var. of *subrogātus;* see SUBROGATE] —**sur′ro·gate·ship′,** *n.* —**sur′ro·ga′tion,** *n.*

sur′rogate moth′er, **1.** a person who acts in the place of another person's biological mother. **2.** an animal that is given another's offspring to raise. **3.** *Med.* a woman who helps a couple to have a child by carrying to term an embryo conceived by the couple and transferred to her uterus, or by being inseminated with the man's sperm and either donating the embryo for transfer to the woman's uterus or carrying it to term. Cf. **embryo transfer.** [1975–80]

sur·round (sə round′), *v.t.* **1.** to enclose on all sides; encompass: *She was surrounded by reporters.* **2.** to form an enclosure round; encircle: *A stone wall surrounds the estate.* **3.** to enclose (a body of troops, a fort or town, etc.) so as to cut off communication or retreat. —*n.* **4.** something that surrounds, as the area, border, etc., around an object or central space: *a tile surround for the shower stall.* **5.** environment or setting: *The designer created a Persian surround for the new restaurant.* **6.** *Hunting.* **a.** a means of hunting in which wild animals are encircled and chased into a special spot that makes their escape impossible. **b.** the act of hunting by this means. **c.** the location encircled by hunters using this means. [1400–50; late ME *surounden* to inundate, submerge < AF *surounder,* MF *s(o)ronder* < LL *superundāre* to overflow, equiv. to L *super-* SUPER- + *undāre* to flood, deriv. of *unda* wave (see UNDULATE); current sp. by analysis as SUR-¹ + ROUND¹ (v.)]

sur·round·ing (sə roun′ding), *n.* **1.** something that surrounds. **2. surroundings,** environing things, circumstances, conditions, etc.; environment: *He was too sick to be aware of his surroundings.* **3.** the act of encircling or enclosing. —*adj.* **4.** enclosing or encircling. **5.** being the environment or adjacent area. [1400–50; late ME: inundation; see SURROUND, -ING¹, -ING²]

—**Syn. 2.** See **environment.**

surround′ the′ater, a theater, concert hall, or the like, in which seats are arranged around or on all four sides of a central stage. Cf. **arena theater.**

sur·roy·al (sûr roi′əl), *n.* See **crown antler.** [1350–1400; ME *surroyal.* See SUR-¹, ROYAL]

sur·sum cor·da (sŏŏr′sŏŏm kôr′dä, kōr′-), *Eccles.* the words "Lift up your hearts," addressed by the celebrant of the Mass to the congregation just before the preface. [1550–60; < L]

Surt (sûrt, sŏŏrt), *n. Scand. Myth.* the guardian and ruler of Muspelheim, destined to defeat Frey at Ragnarok and destroy the world with fire. [< ON *Surtr,* perh. akin to *svartr* black, with regularly changed vowel (see SWART)]

sur·tax (*n.* sûr′taks′; *v.* sûr′taks′, sûr taks′), *n.* **1.** an additional or extra tax on something already taxed. **2.** one of a graded series of additional taxes levied on incomes exceeding a certain amount. —*v.t.* **3.** to put an additional or extra tax on; charge with a surtax. [1880–85; SUR-¹ + TAX; cf. cf. SUPERTAX, F *surtaxe*]

Sur·tees (sûr′tēz), *n.* **Robert Smith,** 1805–64, English editor and writer.

sur·ti·tle (sûr′tīt′l), *n., v.t.,* **-tled, -tling.** supertitle. [SUR-¹ + TITLE]

sur·tout (sər tōō′, -tōōt′; *Fr.* syr tōō′), *n., pl.* **-touts** (-tōōz′, -tōōts′; *Fr.* -tōō′). **1.** a man's close-fitting overcoat, esp. a frock coat. **2.** a hood with a mantle, worn by women. [1680–90; < F: lit., over all, equiv. to *sur* upon, on (see SUR-¹) + *tout* everything]

Surt·sey (sûrt′sē; *Icel.* sŏŏrt′sā), *n.* an island S of and belonging to Iceland: formed by an undersea volcano 1963. ab. one mi. (1.5 km) in diameter; ab. 500 ft. (150 m) high.

surv., **1.** survey. **2.** surveying. **3.** surveyor.

sur·veil (sər vāl′), *v.t.,* **-veilled, -veil·ling.** to place under surveillance. [1965–70; back formation from SURVEILLANCE]

sur·veil·lance (sər vā′ləns, -vāl′yəns), *n.* **1.** a watch kept over a person, group, etc., esp. over a suspect, prisoner, or the like: *The suspects were under police surveillance.* **2.** supervision or superintendence. [1790–1800; < F, equiv. to *surveill(er)* to watch over (*sur-* SUR-¹ + *veiller* < L *vigilāre* to watch; see VIGIL) + *-ance* -ANCE]

sur·veil·lant (sər vā′lənt, -vāl′yənt), *adj.* **1.** exercising surveillance. —*n.* **2.** a person who exercises surveillance. [1810–20; < F, prp. of *surveiller* (see SURVEILLANCE, -ANT)]

sur·vey (*v.* sər vā′; *n.* sûr′vā, sər vā′), *v., n., pl.* **-veys.** —*v.t.* **1.** to take a general or comprehensive view of or appraise, as a situation, area of study, etc. **2.** to view in detail, esp. to inspect, examine, or appraise formally or officially in order to ascertain condition, value, etc. **3.** to conduct a survey of or among: *to survey TV viewers.* **4.** to determine the exact form, boundaries, position, extent, etc., of (a tract of land, section of a country, etc.) by linear and angular measurements and the application of the principles of geometry and trigonometry. —*v.i.* **5.** to survey land; practice surveying. —*n.* **6.** an act or instance of surveying or of taking a comprehensive view of something: *The course is a survey of Italian painting.* **7.** a formal or official examination of the particulars of something, made in order to ascertain condition, character, etc. **8.** a statement or description embodying the result of this: *They presented their survey to the board of directors.* **9.** a sampling, or partial collection, of facts, figures, or opinions taken and used to approximate or indicate what a complete collection and analysis would reveal: *The survey showed the percentage of the population that planned to vote.* **10.** the act of determining the exact form, boundaries, position, etc., as of a tract of land or section of a country, by linear measurements, angular measurements, etc. **11.** the plan or description resulting from such an operation. **12.** an agency for making determinations: *U.S. Geological Survey.* [1425–75; late ME *surveien* (v.) < AF *surveier,* MF *surv(e)ier,* surveier to oversee, equiv. to *sur-* SUR-¹ + *v(e)ier* < L *vidēre* to see] —**sur·vey′a·ble,** *adj.*

survey., surveying.

sur′vey course′, *Educ.* an introductory course of study that provides a general view of an academic subject. [1915–20]

sur·vey·ing (sər vā′ing), *n.* **1.** the science or scientific method of making surveys of land. **2.** the occupation of one who makes land surveys. **3.** the act of one who surveys: *The surveying required nearly two days.* [1425–75; late ME: act of examining closely; see SURVEY, -ING¹]

sur·vey·or (sər vā′ər), *n.* **1.** a person whose occupation is surveying. **2.** an overseer or supervisor. **3.** *Chiefly Brit.* a person who inspects something officially for the purpose of ascertaining condition, value, etc. **4.** (formerly) a U.S. customs official responsible for ascertaining the quantity and value of imported merchandise. **5.** (*cap.*) *U.S. Aerospace,* one of a series of space probes (1966–68) that analyzed lunar soil and obtained scientific information after soft-landing on the moon. [1375–1425; late ME *surveio(u)r* < AF *surveiour* < *surve(i)our,* equiv. to *surve(i)-* (see SURVEY) + *-our* -OR²] —**sur·vey′or·ship′,** *n.*

survey′or's chain′, See under **chain** (def. 8a).

survey′or's com′pass, an instrument used by surveyors for measuring azimuths. Also called **surveyor's dial.**

survey′or's lev′el, level (def. 9a).

survey′or's meas′ure, a system of units of length used in surveying land, based on the surveyor's chain of 66 ft. (20.12 m) and its 100 links of 7.92 in. (20.12 cm).

sur·viv·a·ble (sər vī′və bəl), *adj.* **1.** able to be survived: *Would an atomic war be survivable?* **2.** capable of withstanding attack or countermeasures: *a bomber survivable against fighter planes.* [1950–55; SURVIVE + -ABLE] —**sur·viv′a·bil′i·ty,** *n.*

sur·vi·val (sər vī′vəl), *n.* **1.** the act or fact of surviving, esp. under adverse or unusual circumstances. **2.** a person or thing that survives or endures, esp. an ancient custom, observance, belief, or the like. **3.** *Anthropology* (in technical use) the persistence of a culturalism longer than other related customs, practice, or the like long after it has lost its original meaning or usefulness. —*adj.* **4.** of, pertaining to, or use in surviving, esp. under adverse or unusual circumstances: *survival techniques.* [1590–1600; SURVIVE + -AL²]

surviv′al curve′, a line or curve plotted on a graph indicating survival rates of a specific population, as breast-cancer patients, over a period of time. [1980–85]

sur·viv·al·ist (sər vī′və list), *n.* a person who makes preparations to survive a widespread catastrophe, as an atomic war or anarchy, esp. by storing food and weapons in a safe place. [1965–70; SURVIVAL + -IST] —**sur·viv·al·ism,** *n.*

surviv′al kit′, **1.** *Mil.* a package containing medicine, supplies, rations, and other vital equipment for use by a person forced to land in or parachute into the ocean, jungle, or other isolated or hostile territory. **2.** a similar emergency kit for campers, hikers, etc.

surviv′al of the fit′test, **1.** (not in technical use) natural selection. **2.** a 19th-century concept of human society, inspired by the principle of natural selection, postulating that those who are eliminated in the struggle for existence are the unfit. [1860–65]

surviv′al val′ue, the utility of a behavioral trait or a physical feature of an organism in aiding the survival and reproduction of the organism.

sur·vive (sər vīv′), *v.,* **-vived, -viv·ing.** —*v.i.* **1.** to remain alive after the death of someone, the cessation of something, or the occurrence of some event; continue to live: *Few survived after the holocaust.* **2.** to remain in existence or use: *Ancient farming methods still survive in the Middle East.* **3.** to get along or remain healthy, happy, and unaffected in spite of something: *She survived after the divorce.* —*v.t.* **4.** to outlive the occurrence: *She's surviving after the death, cessation, etc.* **5.** to continue to live or exist after the death, cessation, or occurrence of: *His wife survived him. He survived the operation.* **6.** to endure or live through (an affliction, adversity, misery, etc.): *She's survived two divorces.* [1425–75; late ME < MF *survivre* < L *supervīvere* to live; see SUR-², equiv. to *super-* SUPER- + *vivere* to live; see VIVID] —**Syn. 1.** persist, succeed. SURVIVE, OUTLIVE refer to remaining alive longer than someone else or after some event. SURVIVE usually means to succeed in keeping alive against odds, to live after some event that has threatened one; *to survive an automobile accident.* OUTLIVE also used of living longer than another person (usually a relative), but, today, mainly in the passive, as in the fixed expression: *The deceased is survived by his wife and children.* OUTLIVE stresses capacity for endurance the time element, and sometimes a sense of competition: *He outlived all his enemies.* It is also used, however, of a person or object that has lived or lasted beyond a certain point: *He has outlived his usefulness.*

sur·vi·vor (sər vī′vər), *n.* **1.** a person or thing that survives. **2.** *Law.* the one of two or more designated persons, as joint tenants or others having a joint interest, who outlives the other or others. **3.** a person who continues to function or prosper in spite of opposition, misfortune, ship, or setbacks. [1495–1505; SURVIVE + -OR²]

surviv′or guilt′, *Psychiatry.* feelings of guilt experienced by a person having survived a catastrophe in which others died. Also called **survivor syndrome.** [1970–75]

EXHIBIT 12

PAT-NO: JP408171076A

DOCUMENT-IDENTIFIER: JP 08171076 A

TITLE: LIQUID CRYSTAL DISPLAY ELEMENT AND ITS PRODUCTION

PUBN-DATE: July 2, 1996

INVENTOR-INFORMATION:
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APPL-NO: JP06334977

APPL-DATE: December 19, 1994

INT-CL (IPC): G02F001/13, G02F001/1333 ,

G02F001/1343

ABSTRACT:

PURPOSE: To efficiently and inexpensively produce a liquid crystal display element by making it possible to simultaneously process two kinds of electrode substrates in parallel even in a limited production space, thereby averting excess quality.

CONSTITUTION: A pair of the electrode substrates formed with cut parts varying in sizes in corner parts are sent from a prepn. stage through, for example, a loader stage 15, a washing stage 16 and a resist applying stage 17 to a discriminating stage 18. The respective electrode substrates are discriminated in accordance with the respective cut parts in this discriminating stage 18. The discriminated electrode substrates are respectively subjected to parallel treatments in exposing stages 19, 20 of respectively separate lines. The respective electrode substrates fed in the separate lines are collected to one line and are subjected to the canon processing in a developing stage 21. There is no need for using two lines of the production lines to be exclusively used for respective production of the respective electrode substrates like

heretofore or using one production line by changing over the line at every specified time is eliminated the simultaneous and parallel processing of two kinds of the electrode substrates in the limited production space is possible.

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(51)Int.Cl.⁶		識別記号	庁内整理番号	ＦＩ	技術表示箇所
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	1/1333	５００			
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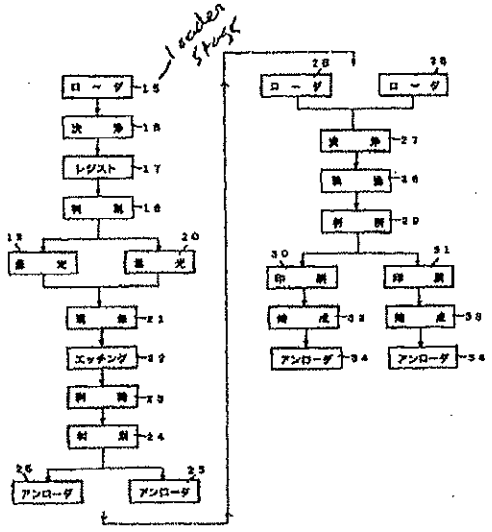
(54)【発明の名称】 液晶表示素子およびその製造方法

(57)【要約】
【目的】 限られた製造スペースでも２種類の電極基板を同時に並列処理でき、過剰品質を回避して液晶表示素子を効率良く安価に生産する。
【構成】 コーナ部分に大きさの異なるカット部が形成された一対の電極基板が準備工程から例えばローダ工程１５、洗浄工程１６、およびレジスト塗布工程１７を経て判別工程１８に送り込まれると、この判別工程１８で各電極基板それぞれを各カット部に基づいて判別し、判別された各電極基板それぞれを別々のラインの露光工程１９、２０で並列処理し、別々のラインで送られた各電極基板を現像工程２１で１本のラインにまとめて共通の処理をする。したがって、電極基板を２種類にしても、従来のように各電極基板をそれぞれ製造する２本の専用製造ラインを用いたり、１本の製造ラインを一定時間ごとに切り換えて使用したりする必要がなく、限られた製造スペースでも２種類の電極基板を同時に並列処理できる。



1

【特許請求の範囲】

【請求項1】 対向面にそれぞれ電極およびこの電極を覆う配向膜が形成された一対の電極基板間に液晶を封入した液晶表示素子において、

前記一対の電極基板にそれぞれを互いに判別可能にする判別情報供給手段を設けたことを特徴とする液晶表示素子。

【請求項2】 前記判別情報供給手段は、前記一対の電極基板それぞれの形状の差であることを特徴とする請求項1記載の液晶表示素子。

【請求項3】 前記判別情報供給手段は、前記一対の電極基板それぞれの厚さの差であることを特徴とする請求項1記載の液晶表示素子。

【請求項4】 前記判別情報供給手段は、前記一対の電極基板それぞれの材質の差であることを特徴とする請求項1記載の液晶表示素子。

【請求項5】 前記判別情報供給手段は、前記一対の電極基板の前記電極それぞれの膜厚の差であることを特徴とする請求項1記載の液晶表示素子。

【請求項6】 前記判別情報供給手段は、前記一対の電極基板の前記電極それぞれの材質の差であることを特徴とする請求項1記載の液晶表示素子。

【請求項7】 前記判別情報供給手段は、前記電極基板と前記電極とを合わせた全体のそれぞれの厚さの差であることを特徴とする請求項1記載の液晶表示素子。

【請求項8】 前記判別情報供給手段は、前記一対の電極基板に形成された識別マークであることを特徴とする請求項1記載の液晶表示素子。

【請求項9】 対向面に電極膜が形成され、かつ両者を判別可能にする判別情報供給手段を備えた一対の電極基板を準備する準備工程と、

前記判別情報供給手段に基づいて前記一対の電極基板のそれぞれを判別する判別工程と、

前記判別工程で判別された前記各電極基板をそれぞれ別のラインで搬送しながら並列処理する並列処理工程と、

前記並列処理工程の別々のラインで搬送されてきた前記各電極基板を1本のラインにまとめて順次搬送しながら共通の処理をする共通処理工程と、

からなることを特徴とする液晶表示素子の製造方法。

【請求項10】 前記判別工程、前記並列処理工程、および前記共通処理工程は、繰り返し行なわれることを特徴とする請求項9記載の液晶表示素子の製造方法。

【請求項11】 前記並列処理工程は、前記電極膜を所定形状の電極にパターニングするためのフォトレジストの露光工程であることを特徴とする請求項9または10記載の液晶表示素子の製造方法。

【請求項12】 前記並列処理工程は、前記電極膜が所定形状にパターニングされた電極を覆う配向膜を形成する配向膜形成工程であることを特徴とする請求項9または10記載の液晶表示素子の製造方法。

2

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は、液晶表示素子およびその製造方法に関する。

【0002】

【従来の技術】一般に、液晶表示素子は、一対の電極基板の対向面にそれぞれ透明導電材料からなる電極およびこの電極を覆う配向膜が形成され、これら一対の電極基板間に液晶がシール材によって封入された構造になっている。この場合、一方の電極基板には電極として信号電極が形成され、他方の電極基板には電極としてコモン電極が形成されている。このような液晶表示素子では、通常、部品点数や製造工程などの煩雑さを避けるために、一対の電極基板および各電極がその材料や膜厚などを同じにした同一仕様になっている。

【0003】

【発明が解決しようとする課題】しかしながら、このような液晶表示素子では、一般に、信号電極はコモン電極よりも長さが短くコモン電極よりも電気抵抗が高くても良いので、コモン電極の膜厚よりも薄く形成することができるが、一対の電極基板および各電極を同一仕様とするためには、信号電極もコモン電極と同じ厚さに形成されることになり、一方が他方に対して過剰品質になり、この分コスト高になるという問題があった。このようなことから、一対の電極基板を2種類にすることが検討されている。このように一対の電極基板を2種類にした場合には、以下のような製造方法を採用する必要がある。すなわち、各電極基板をそれぞれ製造するための2本の専用の製造ラインを用いる方法、あるいは1本の製造ラインを一定時間ごとに切り換えて使用する方法などがある。しかしながら、前者の製造方法では、2本の専用の製造ラインを設置しなければならないため、広い製造スペースが必要で、設備費用がかさみ、製造コストが高くなるという問題が生じる。また、後者の製造方法では、1本の製造ラインを一定時間ごとに切り換えて使用するため、生産効率が悪く、生産能力が低下するという問題が生じる。

【0004】この発明の第1の目的は、一対の電極基板をそれぞれ別の種類にして過剰品質を防ぎ、低価格化を図ることのできる液晶表示素子を提供することである。また、この発明の第2の目的は、限られた製造スペースでも2種類の電極基板を同時に並列処理でき、効率良く生産することのできる液晶表示素子の製造方法を提供することである。

【0005】

【課題を解決するための手段】請求項1記載の発明は、上記第1の目的を達成するため、対向面にそれぞれ電極およびこの電極を覆う配向膜が形成された一対の電極基板間に液晶を封入した液晶表示素子において、一対の電極基板にそれぞれを互いに判別可能にする判別情報供給

手段を設けたことを特徴とするものである。この場合、請求項1～8に記載の如く、判別情報供給手段は、一対の電極基板それぞれの形状の差、一対の電極基板それぞれの厚さの差、一対の電極基板それぞれの材質の差、一対の電極基板の電極それぞれの膜厚の差、一対の電極基板の電極それぞれの材質の差、電極基板と電極とを合わせた全体のそれぞれの厚さの差、一対の電極基板にそれぞれ形成された識別マークなどのいずれかであることが望ましい。

【0006】また、請求項9記載の発明は、上記第2の目的を達成するため、対向面に電極膜が形成され、かつ両者を判別可能にする判別情報供給手段を備えた一対の電極基板を準備する準備工程と、判別情報供給手段に基づいて一対の電極基板のそれぞれを判別する判別工程と、この判別工程で判別された各電極基板をそれぞれ別のラインで搬送しながら並列処理する並列処理工程と、この並列処理工程の別々のラインで搬送されてきた各電極基板を1本のラインにまとめて順次搬送しながら共通の処理をする共通処理工程とからなることを特徴とするものである。この場合、請求項10に記載の如く、判別工程、並列処理工程、および共通処理工程は、繰り返し行なわれることが望ましい。また、請求項11に記載の如く、並列処理工程は電極膜を所定形状の電極にパターニングするためのフォトレジストの露光工程であり、また請求項12に記載の如く、電極膜が所定形状にパターニングされた電極を覆う配向膜を形成する配向膜形成工程であることが望ましい。

【0007】

【作用】請求項9記載の発明によれば、判別情報供給手段を備えた一対の電極基板が準備工程から判別工程に送り込まれると、この判別工程で一対の電極基板のそれぞれを判別情報供給手段に基づいて判別し、判別された各電極基板それぞれを並列処理工程の別々のラインで搬送しながら並列処理し、別々のラインで搬送されてきた前記各電極基板を共通処理工程で1本のラインにまとめて順次搬送しながら共通の処理をするので、電極基板を2種類にしても、従来のように各電極基板をそれぞれ製造するための2本の専用の製造ラインを用いたり、あるいは1本の製造ラインを一定時間ごとに切り換えて使用したりする必要がなく、限られた製造スペースでも2種類の電極基板を同時に並列処理でき、効率良く生産することができる。

【0008】また、請求項1記載の発明によれば、一対の電極基板のそれぞれを判別可能にする判別情報供給手段を備えているので、電極基板を2種類にしても、請求項9に記載の如く判別情報供給手段に基づいて2種類の電極基板を判別して別々のラインで同時に並列処理でき、効率良く生産することができ、したがって一対の電極基板それぞれの材質や厚さ、あるいは各電極の材質や厚さなどを種類ごとに変えることにより、電極を有する

一対の電極基板をそれぞれ別の種類にして過剰品質を防ぐことができ、これにより製品の単価を下げることができ、製品の低価格化を図ることができる。

【0009】

【実施例】以下、図1～図3を参照して、この発明の液晶表示素子およびその製造方法の一実施例について説明する。図1はこの発明の液晶表示素子を示す断面図である。この液晶表示素子は、ガラスや合成樹脂などからなる一対の電極基板1、2の対向面に電極3、4および各電極3、4をそれぞれ覆う配向膜5、6が形成され、これら一対の電極基板1、2の対向する配向膜5、6間に液晶7がシール材8により封入された構造になっている。

【0010】電極3、4はITOなどの透明な導電材料からなり、一方の電極基板1の電極3は左右方向に長い帯状のコモン電極であり、他方の電極基板2の電極4は紙面の表裏方向に長い帯状の信号電極であり、各電極3、4は互いに直交した状態で対向している。また、信号電極4は、コモン電極3よりも長さが短くなっており、このためコモン電極3のように電気抵抗を低く押える必要がないので、コモン電極4よりも膜厚が薄く形成されている。したがって、一対の電極基板1、2は、同一仕様でなく、それぞれ仕様が異なっている。

【0011】また、一方の電極基板1のコーナ部分には、判別情報供給手段として、例えば図2（a）に示すように、2mmの隅切りカット部10が形成されている。このカット部10に対応する他方の基板2のコーナ部分には、判別情報供給手段として、例えば図2（b）に示すように、4mmの隅切りカット部11が形成されている。これにより、一対の電極基板1、2は、カット部10、11の大きさが異なることにより、それぞれ異なった形状に形成されていることになる。なお、カット部10、11の大きさは2mm単位で形成されているが、その理由は現状の接触式センサによる検出が2mmの外形差を有していないと不可能になるからである。

【0012】次に、図3を参照して、この液晶表示素子の製造方法について説明する。まず、仕様の異なる2種類の電極基板1、2を準備する。すなわち、準備された電極基板1、2のうち、一方の電極基板1には予めコモン電極3用の電極膜が所定の膜厚で形成されており、コーナ部分には2mmのカット部10が形成されている。また、他方の電極基板2には予め信号電極4用の電極膜がコモン電極3用の電極膜よりも薄い膜厚で形成されており、コーナ部分には4mmのカット部11が形成されている。

【0013】そして、各電極基板1、2は、ローダ工程15から順次洗浄工程16に送り込まれて洗浄され、レジスト工程17に搬送され、このレジスト工程17で各電極基板1、2の電極膜上にフォトレジストが塗布される。フォトレジストが塗布された各電極基板1、2は、

判別工程１８で各種類ごとに判別されて振り分けられる。すなわち、この判別工程１８では、各電極基板１、２のそれぞれのカット部１０、１１が接触式センサなどで検知されることにより、各電極基板１、２の種類が判別される。そして、各種類ごとに判別されて振り分けられた各電極基板１、２は、それぞれ別のラインの各露光工程（並列処理工程）１９、２０に搬送される。各露光工程１９、２０では、各ラインごとにコモン電極３および信号電極４の各電極パターンに応じたそれぞれのマスクを用いてフォトレジストを露光する。また、この露光工程１９、２０では、各種類の電極基板１、２をそれぞれ同時に並列処理する。

【００１４】この後、露光工程１９、２０の別々のラインで搬送された各電極基板１、２は、それぞれ１本のラインにまとめられ、共通処理工程の１つである現像工程２１に順次送り込まれ、この現像工程２１で各電極基板１、２のフォトレジストがそれぞれ現像された上、エッチング工程２２に送り込まれる。このエッチング工程２２では、それぞれのフォトレジストをマスクとして各電極膜がエッチングされ、これにより各電極３、４がそれぞれ形成される。すなわち、一方の電極基板１にはコモン電極３が、他方の電極基板２には信号電極４がそれぞれ適切な膜厚で形成される。この後、各電極基板１、２は、剥離工程２３に順次送り込まれ、この剥離工程２３で各フォトレジストがそれぞれ剥離された上、次の判別工程２４に送り込まれる。この判別工程２４では、各電極基板１、２が再び上述と同様に各種類ごとに判別されて振り分けられ、それぞれ別々のラインのアンローダ工程２５に送られる。これにより、各電極３、４の形成工程が終了する。

【００１５】次に、アンローダ工程２５から各電極基板１、２がそれぞれ各ローダ工程２６に進み、各ローダ工程２６から各電極基板１、２が再び１本のラインにまとめられ、共通処理工程の１つである洗浄工程２７に各電極基板１、２が順次送り込まれてそれぞれ洗浄された上、次の乾燥工程２８に送り込まれて順次乾燥される。乾燥された各電極基板１、２は、再び判別工程２９で上述と同様に各種類ごとに判別されて振り分けられ、それぞれ並列処理工程の一部である別ラインの各印刷工程３０、３１に搬送され、各電極基板１、２の電極３、４に応じて配向膜が印刷される。そして、配向膜が印刷された各電極基板１、２は、それぞれ別のラインの焼成工程３２、３３に送られて各配向膜がそれぞれ焼成され、それぞれ別のラインのアンローダ工程３４に送られる。これにより、各電極基板１、２に配向膜を形成する配向膜形成工程が終了する。この配向膜形成工程は、一対の電極基板１、２に施す処理は同じであるが、処理に要する時間が長いため、並列処理することにより全体の処理時間の低減に大きく寄与する。

【００１６】なお、この後は、図示しないが、一対の電

極基板１、２の一方の周縁部分にシール材８を印刷し、このシール材８を介して一対の電極基板１、２を張り合わせ、これら一対の電極基板１、２およびシール材８で囲われた領域内にシール材８の注入口から液晶７を注入した上、この注入口を封止することにより、液晶表示素子が完成する。

【００１７】このように、この液晶表示素子の製造方法では、一対の電極基板１、２の各コーナ部分に形成された大きさの異なるカット部１０、１１を判別工程１８、２４、２９で接触式センサなどにより判別し、各電極基板１、２それぞれを並列処理工程である露光工程１９、２０またはアンローダ工程２５もしくは印刷工程３０、３１および焼成工程３２、３３などのそれぞれ別のラインに振り分けて搬送しながら並列処理し、別々のラインで搬送されてきた各電極基板１、２を共通処理工程である現像工程２１、エッチング工程２２および剥離工程２３、または洗浄工程２７および乾燥工程２８などのそれぞれ１本のラインにまとめて順次搬送しながら共通の処理をするので、電極基板１、２を２種類にしても、従来のように各電極基板１、２をそれぞれ製造するための２本の専用の製造ラインを用いたり、あるいは１本の製造ラインを一定時間ごとに切り換えて使用したりする必要がなく、限られた製造スペースでも２種類の電極基板１、２を適宜並列に搬送して同時に所要の処理をすることができ、液晶表示素子を効率良く生産することができる。

【００１８】また、この液晶表示素子では、一対の電極基板１、２の各コーナ部分にそれぞれ異なる大きさのカット部１０、１１を形成することにより、一対の電極基板１、２の形状を異ならせて各電極基板１、２をそれぞれ互いに判別可能にしたので、一対の基板１、２自体の厚さや材質および各電極３、４の膜厚や材質をそれぞれの電極基板に適したものとすることにより、基板や電極の過剰品質を防ぐことができ、これにより製品の単価を下げることができ、製品の低価格化を図ることができる。

【００１９】なお、上記実施例では、一対の電極基板１、２のそれぞれに設ける各電極３、４の膜厚をそれぞれの電極基板に適する固有の厚さにした場合について述べたが、これに限らず、例えば各電極３、４の材質として高価なＩＴＯと安価なSnO_2を電極基板１、２ごとに使い分けても良く、また電極基板１、２自体の厚さを種類ごとに変えても良く、また電極基板１、２としてガラス基板とプラスチック基板、または板状のプラスチック基板とシート状のフィルム基板などのように組み合わせを異ならせても良く、さらにこれらすべての項目をそれぞれ電極基板に適したものにして組み合わせても良い。このようにすれば、製品の単価をより一層下げることができ、極めて低コストの製品を得ることができる。

【００２０】また、上記実施例では、カット部１０、１

1を接触式センサで検知する場合について述べてが、これに限らず、例えば反射率、透過率、屈折率などを測定する光学式、あるいは超音波式などの非接触式センサなどで検知するようにしても良い。

【0021】また、上記実施例では、各電極基板1、2の1つのコーナ部分にそれぞれ大きさの異なるカット部10、11を形成して各電極基板1、2の形状を異ならせたが、これに限らず、例えば一方の基板のみにカット部を形成するだけでも良く、あるいは同じ大きさのカット部を各電極基板1、2の異なる位置に形成しても良く、またカット部の数を各電極基板1、2で異なる数で形成しても良く、さらにこれらを組み合わせても良い。

【0022】さらに、上記実施例では、判別情報供給手段として、一対の電極基板1、2にカット部10、11を形成して各電極基板1、2の形状を異ならせたが、これに限らず、例えば一対の電極基板1、2の各電極3、4の膜厚を異ならせたものでも良く、また一対の電極基板1、2の各電極3、4をITOやSnO_2などのような異なる材質で形成したものでも良い。この場合には判別対象部材の反射率、透過率、屈折率などを光学的に測定し、材質の差を判別すれば良い。また、これに限らず、一対の電極基板1、2の厚さを異ならせたものでも良く、また一対の電極基板1、2としてガラス基板とプラスチック基板、または板状のプラスチック基板とシート状のフィルム基板などを用い、一対の電極基板1、2の材質をそれぞれ異ならせたものでも良い。さらには、一対の電極基板1、2にそれぞれITOなどの電極膜によって設けられた識別マークで判別するようにしても良い。この場合には検査カメラなどで識別マークを読み取って各電極基板1、2の種類を判別すれば良い。

【0023】

【発明の効果】以上説明したように、請求項9記載の液晶表示素子の製造方法によれば、判別情報供給手段を備えた一対の電極基板が準備工程から判別工程に送り込まれると、この判別工程で一対の電極基板のそれぞれを判別情報供給手段に基づいて判別し、判別された各電極基板それぞれを並列処理工程の別々のラインで搬送しながら並列処理し、別々のラインで搬送されてきた各電極基板を共通処理工程で1本のラインにまとめて順次搬送しながら共通の処理をするので、電極基板を2種類にしても、従来のように各電極基板をそれぞれ製造するための

2本の専用の製造ラインを用いたり、あるいは1本の製造ラインを一定時間ごとに切り換えて使用したりする必要がなく、限られた製造スペースでも2種類の電極基板を同時に並列処理でき、液晶表示素子を効率良く生産することができる。また、請求項1記載の液晶表示素子によれば、一対の電極基板のそれぞれを判別可能にする判別情報供給手段を備えているので、電極基板を2種類にしても、請求項9に記載の如く判別情報供給手段に基づいて2種類の電極基板を判別して別々のラインで同時に並列処理でき、液晶表示素子を効率良く生産することができ、したがって一対の基板それぞれの材質や厚さ、あるいは各電極の材質や厚さなどをそれぞれの電極基板に適したものとすることにより、基板や電極などの構成部材の過剰品質を防ぐことができ、これにより製品の単価を下げることができ、製品の低価格化を図ることができる。

【図面の簡単な説明】

【図1】この発明の液晶表示素子の1例を示す要部断面図。

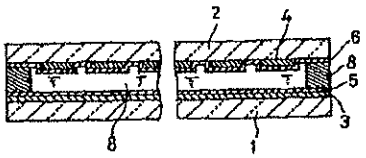
【図2】各電極基板の形状の相違を示し、（a）はコモン電極側の電極基板の平面図、（b）は信号電極側の電極基板の平面図。

【図3】液晶表示素子の製造方法のフローを示す工程図。

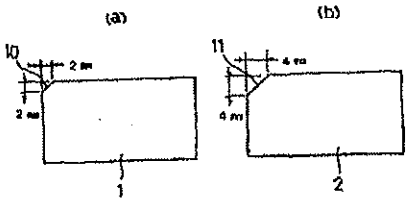
【符号の説明】

1、2　電極基板
3、4　電極
5、6　配向膜
7　液晶
8　シール材
10、11　カット部
18、24、29　判別工程
19、20　露光工程
21　現像工程
22　エッチング工程
23　剥離工程
30、31　印刷工程
32、33　焼成工程
27　洗浄工程
28　乾燥工程

【図1】



【図2】


(a)
(b)
10
11
2 m
2 m
4 m
4 m
1
2

【図3】

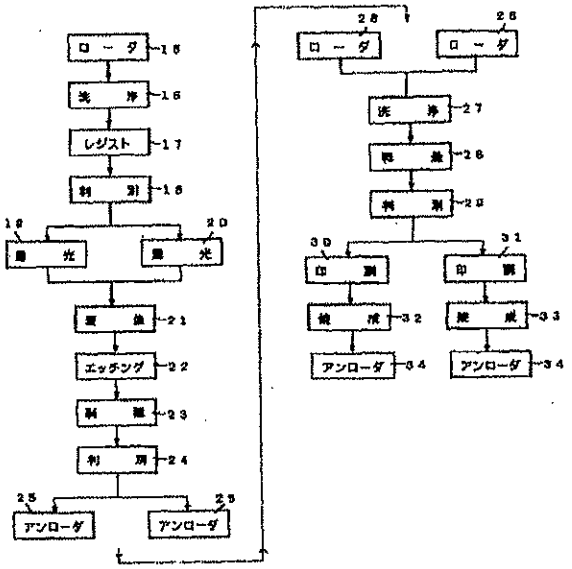

ロ　ー　ダ
洗　浄
レジスト
剥　離
露　光
現　像
エッチング
アンローダ
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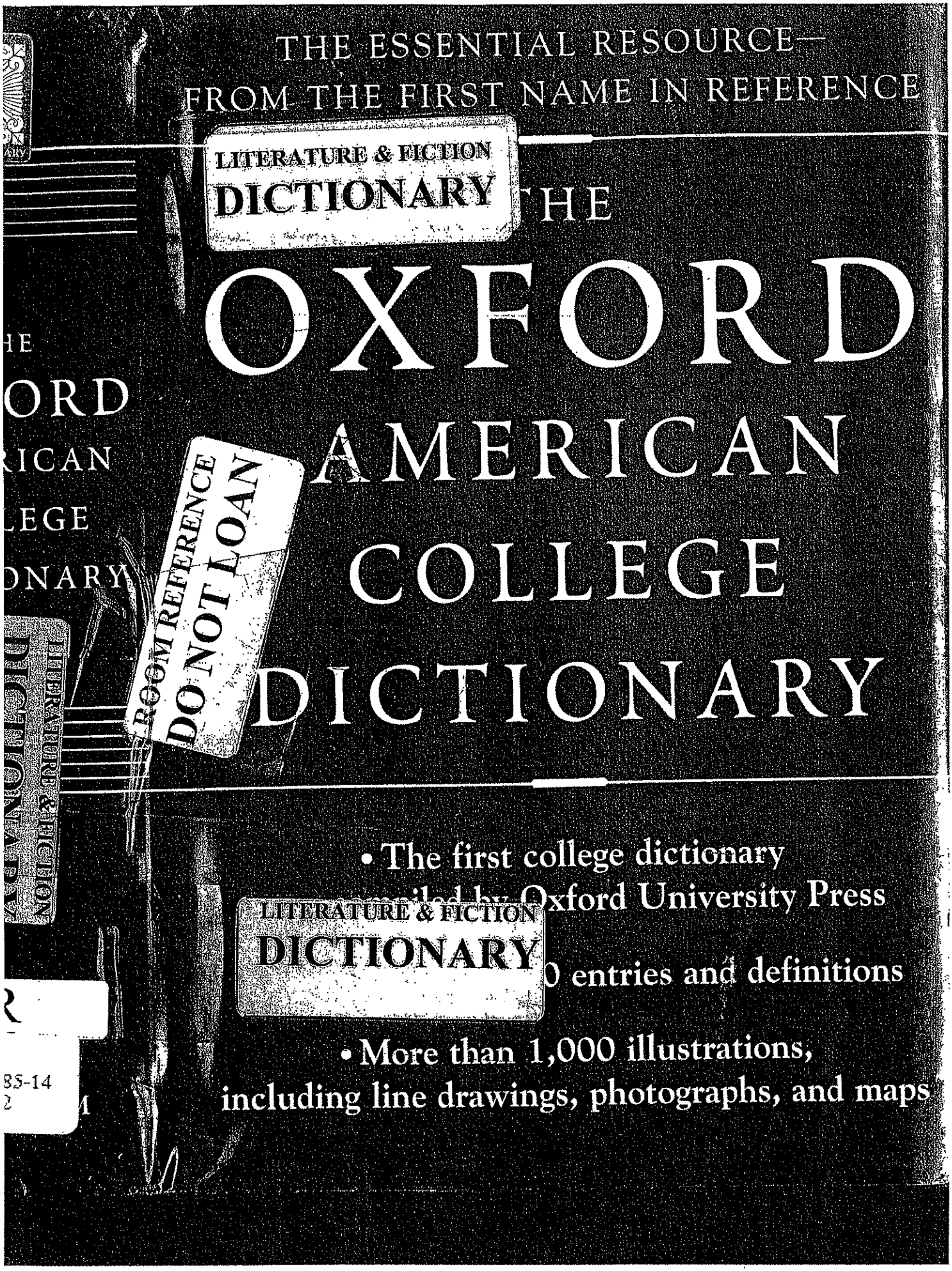
EXHIBIT 13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This book is printed on acid-free paper. ♾

efore a vowel) ▸comb. form relating to
tomy.
on'gastəmē/ ▸n. surgical unblocking

of Latin American dance music inco
f rock. ■ a dance performed to this mu
cooking) a spicy tomato sauce.
, an edible European plant (*Tragopog*
umily, with a long root like that of a
PLANT. ■ the root of this plant used

Arms Limitation Talks.
on salt) sodium chloride (NaCl), a
gives seawater its characteristic taste
reserving food. ■ poetic/literary someth
quancy. ■ a saltcellar. ■ table salt m
; *garlic salt*. 2 Chemistry any chemic
e reaction of an acid with a base, wit
the acid replaced by a metal or othe
ormal an experienced sailor. ▸adj. [
d with, or tasting of salt: *salt water*
ing on the coast or in salt marshes
ed) season or preserve with salt: *cook*
ater. ■ figurative make (something) piqu
ıkle (a road or path) with salt in orde
fraudulently make (a mine) appear to
ch ore into it. 3 [as adj.] (**salted**)
a resistance to disease by survivi
ıdj.
the (or someone's) wound mak
ore painful for someone. **the salt of th**
f people of great kindness, reliabilit
biblical allusion to Matt 5:13.) take
(**or pinch**) **of salt** regard something
part of something. **worth one's s**
ıb or profession specified.
nething away informal secretly sto
ney.
ked or speckled with intermingled dar
ıd-pepper hair.
1 Biology abrupt evolutionary chang
o. 2 Geology the movement of hard m
ice in a turbulent flow of air or wat
; 'sôl-/ adj.
d; ˌsôl-/ ▸adj. chiefly Entomology (esp
eaping.
arne house having up to three stories
he back with a steeply pitched roof

a salt-tolerant orache plant sometim
aline soils or to provide grazing in ar

(*Tamarix gallica*) with reddish-brow
foliage.
a container for storing salt, typically
ıations.
d structure in sedimentary rocks, form
as been forced upward.
a person dealing in or employed in
n whose work involved the preservation

pools in which seawater is left to
at land covered with a layer of salt
▸n. grass (esp. *Distichlis spicata*) gro
aline regions.
northern Mexico, capital of the state

ɔkə/ ▸n. a dish consisting of roll
oked with herbs, bacon, and other

crisp, savory cracker sprinkled with

raldry another term for **St. Andrew**
m) incorporating a motif based on
wise /-ˌwīz/ adv.
f Utah, in the northern part of the state
d in 1847 by Brigham Young.
mals go to lick salt from the ground.
imals to lick.
ıstal grassland that is regularly floode

that is subject to flooding by seawa

ake in southeastern California, creat
olorado River.
er or depression in the ground in wh
a deposit of salt.

salt•pe•ter /sôltˈpētər/ (Brit. **saltpetre**) ▸n. another term for **POTASSIUM NITRATE**.

salt•wa•ter /ˈsôltˌwôtər; -ˌwätər/ ▸adj. [attrib.] of or found in salt water; living in the sea: *saltwater fish*.

salt•wa•ter croc•o•dile ▸n. a large and dangerous crocodile (*Crocodylus porosus*) occurring in estuaries and coastal waters from southwestern India to northern Australia.

salt•wort /ˈsôltwərt; -ˈwôrt/ ▸n. a plant (genus *Salsola*) of the goosefoot family that typically grows in salt marshes. It is rich in alkali, and its ashes were formerly used in soap-making.

salt•y /ˈsôltē/ ▸adj. (**saltier**, **saltiest**) tasting of, containing, or preserved with salt. ■ (of language or humor) down-to-earth; coarse. ■ informal tough; aggressive. —**salt•i•ness** n.

sa•lu•bri•ous /səˈlo͞obrēəs/ ▸adj. health-giving; healthy: *salubrious weather*. ■ (of a place) pleasant; not run-down. —**sa•lu•bri•ous•ly** adv.; **sa•lu•bri•ous•ness** n.; **sa•lu•bri•ty** /-brətē/ n.

sa•lut /sæˈlo͞o; sāˈlyt/ ▸exclam. used to express friendly feelings toward one's companions before drinking.

sal•u•tar•y /ˈsælyəˌterē/ ▸adj. (esp. with reference to something unwelcome or unpleasant) producing good effects; beneficial.

sal•u•ta•tion /ˌsælyəˈtāSHən/ ▸n. a gesture or utterance made as a greeting or acknowledgment of another's arrival or departure. ■ a standard formula of words used in a letter to address the person being written to. —**sal•u•ta•tion•al** /-SHənl/ adj.

sa•lu•ta•to•ri•an /səˌlo͞otəˈtôrēən/ ▸n. the student who ranks second highest in a graduating class and delivers the salutatory.

sa•lu•ta•to•ry /səˈlo͞otəˌtôrē/ ▸adj. (esp. of an address) relating to or of the nature of a salutation. ▸n. (pl. **-ies**) an address of welcome, esp. one given as an oration by the student ranking second highest in a graduating class at a high school or college.

sa•lute /səˈlo͞ot/ ▸n. a gesture of respect, homage, or polite recognition or acknowledgment, esp. one made to or by a person when arriving or departing. ■ a prescribed movement, typically a raising of the hand to the head, made by a member of a military or similar force as a formal sign of respect or recognition. ■ (often with adj.) the discharge of a gun or guns as a formal or ceremonial sign of respect or celebration. ▸v. [trans.] make a formal salute to. ■ greet. ■ show or express admiration and respect for. —**sa•lut•er** n.

Sal•va•dor /ˈsælvəˌdôr; ˌsælvəˈdôr/ a city on the Atlantic coast of eastern Brazil, capital of the state of Bahia; pop. 2,075,000. Former name **BAHIA**.

Sal•va•dor•ean /ˌsælvəˈdôrēən/ ▸adj. of or relating to El Salvador. ▸n. a native or inhabitant of El Salvador.

sal•vage /ˈsælvij/ ▸v. [trans.] rescue (a wrecked or disabled ship or its cargo) from loss at sea. ■ retrieve or preserve (something) from potential loss or adverse circumstances. ▸n. the rescue of a wrecked or disabled ship or its cargo from loss at sea. ■ the cargo saved from a wrecked or sunken ship. ■ the rescue of property or material from potential loss or destruction. —**sal•vage•a•ble** adj.; **sal•vag•er** n.

sal•va•tion /sælˈvāSHən/ ▸n. Theology deliverance from sin and its consequences. ■ preservation or deliverance from harm, ruin, or loss. ■ (**one's salvation**) a source or means of being saved in this way: *his only salvation was to outfly the enemy*.

Sal•va•tion Army (abbr.: **SA**) a worldwide Christian evangelical organization on quasi-military lines. Established by William Booth, it is noted for its work with the poor and for its brass bands. —**sal•va•tion•ism** /-ˌnizəm/ n.; **sal•va•tion•ist** /sælˈvāSHənist/ n.

sal•ve[1] /sæv; säv/ ▸n. an ointment used to promote healing of the skin or as protection. ■ figurative something that is soothing or consoling for wounded feelings or an uneasy conscience: *the idea provided him with a salve for his guilt*. ▸v. [trans.] archaic apply salve to. ■ figurative soothe (wounded pride or one's conscience): *charity salves our conscience*.

sal•ve[2] /sælv/ ▸v. archaic term for **SALVAGE**. —**salv•a•ble** /ˈsælvəbəl/ adj.

sal•ver /ˈsælvər/ ▸n. a tray, typically one made of silver and used in formal circumstances.

Sal•ve Re•gi•na /ˈsälvā rəˈjēnə/ ▸n. a Roman Catholic hymn or prayer said or sung after compline, and after the Divine Office from Trinity Sunday to Advent.

sal•vi•a /ˈsælvēə/ ▸n. a widely distributed plant (genus *Salvia*) of the mint family, esp. (in gardening) a bedding plant cultivated for its spikes of bright flowers.

sal•vo /ˈsælˌvō/ ▸n. (pl. **-os** or **-oes**) a simultaneous discharge of artillery or other guns in a battle. ■ a number of weapons released from one or more aircraft in quick succession. ■ figurative a sudden, vigorous, or aggressive act or series of acts: *the pardons provoked a salvo of accusations*.

sal vo•la•ti•le /ˌsæl vəˈlætl-ē/ ▸n. a scented solution of ammonium carbonate in alcohol, used as smelling salts.

sal•vor /ˈsælvər/ ▸n. a person engaged in salvage of a ship or items lost at sea.

Sal•ween /ˈsælˌwēn/ a river in Southeast Asia that rises in Tibet and flows for 1,500 miles (2,400 km) southeast and south through Myanmar (Burma) to the Gulf of Martaban, an inlet of the Andaman Sea.

Sal•yut /ˈsælˌyo͞ot/ a series of seven Soviet manned orbiting space stations, launched between 1971 and 1982.

Salz•burg /ˈsôlzˌbərg; ˈslälz-; ˈzält͡sˌbo͝ork/ a city in western Austria, near the border with Germany, the capital of a state of the same name; pop 144,000. It is noted for its annual music festivals.

Salz•git•ter /ˈzält͡sˌgitər/ an industrial city in Germany, in Lower Saxony, southeast of Hanover; pop. 115,000.

SAM /sæm/ ▸abbr. surface-to-air missile.

Sam. ▸abbr. Bible Samuel.

sa•ma•dhi /səˈmädē/ ▸n. (pl. **samadhis**) Hinduism & Buddhism a state of intense concentration achieved through meditation. In Hindu yoga this is regarded as the final stage, at which union with the divine is reached (before or at death). ■ Indian a funerary monument.

Sa•mar /ˈsäˌmär/ an island in the Philippines, southeast of Luzon. It is the third largest island in the group.

Sam•a•ra /səˈmärə/ a city and river port in southwestern central Russia, situated on the Volga River at its confluence with the Samara River; pop. 1,258,000. Former name (1935–91) **KUIBYSHEV**.

sam•a•ra /ˈsæmərə; səˈmerə/ ▸n. Botany a winged nut or achene containing one seed, as in ash and maple.

Sa•mar•i•a /səˈmerēə/ 1 an ancient city in central Palestine, founded in the 9th century BC as the capital of the northern Hebrew kingdom of Israel. The ancient site is situated in the modern West Bank, northwest of Nablus. 2 the region of ancient Palestine around this city, between Galilee in the north and Judaea in the south.

Sam•a•rin•da /ˌsæməˈrində/ a city in Indonesia, in eastern Borneo; pop. 265,000.

Sa•mar•i•tan /səˈmerətn; -ˈmer-/ ▸n. 1 (usu. **good Samaritan**) a charitable or helpful person (with reference to Luke 10:33). 2 a member of a people inhabiting Samaria in biblical times, or of the modern community in the region of Nablus claiming descent from them, adhering to a form of Judaism accepting only its own ancient version of the Pentateuch as Scripture. 3 the dialect of Aramaic formerly spoken in Samaria. ▸adj. of or relating to Samaria or the Samaritans. —**Sa•mar•i•tan•ism** /-ˌizəm/ n.

sa•mar•i•um /səˈmerēəm/ ▸n. the chemical element of atomic number 62, a hard, silvery-white metal of the lanthanide series. (Symbol: Sm)

Sam•ar•kand /ˈsæmərˌkænd; səmərˈkänd/ (also **Samarqand**) a city in eastern Uzbekistan; pop. 370,000. One of the oldest cities in Asia, it was founded in the 3rd or 4th millennium BC. It was a prosperous center on the Silk Road and, in the 14th century, became the capital of Tamerlane's Mongol empire.

Sa•ma Ve•da /ˈsämə ˈvādə; ˈvēdə/ Hinduism one of the four Vedas, a collection of liturgical chants chanted aloud at the sacrifice. Its material is drawn largely from the Rig Veda. See **VEDA**.

sam•ba /ˈsæmbə; ˈsäm-/ ▸n. a Brazilian dance of African origin. ■ a piece of music for this dance. ■ a lively modern ballroom dance imitating this dance. ▸v. (**sambas**, **sambaed** or **samba'd**, **sambaing** /-bə,ɪNG/) [initrans.] dance the samba.

sam•bal /ˈsämbäl/ ▸n. (in oriental cooking) hot relish made with vegetables or fruit and spices.

sam•bar /ˈsämbər; ˈsæm-/ ▸n. a dark brown woodland deer (*Cervus unicolor*) with branched antlers, of South Asia and the Philippines.

sam•bhar /ˈsämbər; ˈsæm-/ ▸n. a spicy southern Indian dish consisting of lentils and vegetables.

Sam•bo /ˈsæmbō/ ▸n. (pl. **-os** or **-oes**) 1 offensive a black person. [ORIGIN: early 18th cent.: perhaps from Fula *sambo* 'uncle.'] 2 (**sambo**) historical a person of mixed race, esp. of black and Indian or black and European blood. [ORIGIN: mid 18th cent.: from American Spanish *zambo*, denoting a kind of yellow monkey.]

Sam Browne belt /sæm 'brown/ ▸n. a leather belt with a supporting strap that passes over the right shoulder, worn by army and police officers.

sam•bu•ca /sæmˈbo͝okə/ ▸n. an Italian aniseed-flavored liqueur.

Sa•me /ˈsämē/ ▸plural n. variant spelling of **SAMI**.

same /sām/ ▸adj. (**the same**) 1 identical; not different; unchanged: *he's worked at the same place for quite a few years* | *I'm the same age as you are* | [with clause] *he put on the same costume that he had worn in Ottawa*. ■ (**this/that same**) referring to a person or thing just mentioned: *that same year I went to Boston*. 2 of an identical type: *they all wore the same clothes*. ▸pron. 1 (**the same**) the same thing as something previously mentioned: *I'll resign and encourage everyone else to do the same*. ■ people or things that are identical or share the same characteristics: *there are several brands and they're not all the same*. 2 (chiefly in formal or legal use) the person or thing just mentioned: *sighted sub, sank same*. ▸adv. similarly; in the same way: *treating women the same as men* | *he gave me five dollars, same as usual*. —**same•ness** n.

PHRASES **all** (or **just**) **the same** in spite of this; nevertheless: *she knew they had meant it kindly, but it had hurt all the same*. ■ in any case; anyway: *I can manage alone, thanks all the same*. **at the same time** 1 simultaneously. 2 on the other hand; nevertheless; yet: *it's a very creative place, but at the same time it's very relaxing*. **be all the same to** be unimportant to (someone) what happens: *it was all the same to me where it was being sold*. **by the same token** see **TOKEN**. **one and the same** the same person or thing (used for emphasis): *the guy in the glasses and Superman were one and the*

See page xiii or the Key to the pronunciations

declaring someone bankrupt. ■
a government spending. ■ Chem
stance. 2 the action of isolatin

iny disk sewn as one of many
ical a Venetian gold coin.

wood tree, esp. the California

ational park in the Sierra Nevada
as established in 1890 to prote

-1843), Cherokee Indian scholar
ia; Cherokee name *Sogwali*; also
ist. He invented a writing system
tge. The giant sequoia trees of Ca

ion.

dge of ice on the surface of a gla

l the women's apartments (harem)
m for HAREM (sense 2). 2 (the
ce, esp. the Sultan's court and gov
e.
CARAVANSARY (sense 1).
▸n. a shawl or blanket worn as a

/-ˌfim/ or **seraphs**) an angelic be
ian angelology as belonging to the
elestial hierarchy, associated with

eristic of or resembling a seraph or
•raph•i•cal•ly /-ik(ə)lē/ adv.
logy a god whose cult was devel
a combination of Apis and Osiris)
a common worship.
l of Serbia. ■ a person of Serbian
rbia, the Serbs, or their language.
Balkans, part of Yugoslavia; pop.
o-Croat; capital, Belgrade.
th Slavic language of the Serbs, alt
itten in the Cyrillic alphabet. See
for SERB. ▸adj. of or relating to
e.
n and . . . : *Serbo-Croat*. ■ relat-

krōt/ (also **Serbo-Croatian** /krō
guage spoken in Serbia, Croatia,
oslavia. Serbo-Croat is generally
prises two closely similar forms:
lphabet, and Croat, written in the
ng to this language.

cession of plant (or animal) com-
colonized habitat to the appropri-
ith SUCCESSION.
e of music sung or played in the
ht under the window of his lover.
[trans.] entertain (someone) with

a cantata with a pastoral subject.
stra or wind band.
the occurrence and development
beneficial way: *a fortunate stroke*
us /-ˈdipitəs/ adj.; **ser•en•dip•i•**

eful, and untroubled; tranquil; *se-*
title) used as a term of respect for
l families: *His Serene Highness*.
xpanse of clear sky or calm sea.

n Tanzania, west of the Great Rift
here.
the state of being calm, peaceful,
y. ■ (**His/Your, etc., Serenity**) a
similar dignitary.
bound under the feudal system to
age /-fij/ n.; **serf•dom** /-dəm/ n.
olen or worsted fabric. ▸v. [trans.]
aterial) to prevent fraying.
umissioned officer in the armed
rmy or Marine Corps) an NCO
staff sergeant, or (in the US Air
rman and below staff sergeant.
w an inspector. ■ a police officer
geant•cy /-jənsē/ n. (pl. -cies).
-at-arms)

Sergeant Baker ▸n. Austral. a brightly colored edible marine fish (*Aulopus purpurissatus*, family Aulopidae) with two elongated dorsal fin rays, occurring in warm Australian coastal waters.

sergeant first class ▸n. a noncommissioned officer in the US Army of a rank above staff sergeant and below master sergeant.

sergeant fish ▸n. another term for COBIA.

sergeant major ▸n. 1 an noncommissioned officer in the US Army or Marine Corps of the highest rank, above master sergeant and below warrant officer. 2 a warrant officer in the British army. 3 a fish (*Abudefduf saxatilis*, family Pomacentridae) with boldly striped sides that lives in warm seas, typically on coral reefs.

serger /ˈsərjər/ ▸n. a sewing machine used for overcasting to prevent material from fraying at the edge.

Sergius, St. /ˈsərjēəs/ (1314–92), Russian reformer and mystic; Russian name *Svyatoi Sergi Radonezhsky*. He inspired the resistance that saved Russia from the Tartars in 1380.

serial /ˈsirēəl/ ▸adj. 1 consisting of, forming part of, or taking place in a series: *a serial publication*. ■ Music using transformations of a fixed series of notes. ■ Computing (of a device) involving the transfer of data as a single sequence of bits. See also SERIAL PORT. ■ Computing (of a processor) running only a single task, as opposed to multitasking. 2 [attrib.] (of a criminal) repeatedly committing the same offense and typically following a characteristic, predictable behavior pattern: *a suspected serial rapist*. ■ (of a person) repeatedly following the same behavior pattern: *he was a serial adulterer*. ■ denoting an action or behavior pattern that is committed or followed repeatedly: *serial killings | serial monogamy*. ▸n. a story or play appearing in regular installments on television or radio or in a magazine or newspaper. ■ (usu. **serials**) (in a library) a periodical. —**serial•ly** /ˈsirēəlē/ n.; **serial•ly** adv.

serial•ism /ˈsirēəˌlizəm/ ▸n. Music a compositional technique in which a fixed series of notes, esp. the twelve notes of the chromatic scale, are used to generate the harmonic and melodic basis of a piece and are subject to change only in specific ways. The first fully serial movements appeared in 1923 in works by Arnold Schoenberg. See also TWELVE-TONE. —**serial•ist** adj. & n.

serial•ize /ˈsirēəˌlīz/ ▸v. [trans.] 1 publish or broadcast (a story or play) in regular installments. 2 arrange (something) in a series: *each document sent to investors should be individually numbered or serialized*. ■ Music compose according to the techniques of serialism. —**serial•i•za•tion** /ˌsirēəlīˈzāshən/ n.

serial number ▸n. a number showing the position of an item in a series, esp. one printed on paper currency or on a manufactured article for the purposes of identification.

serial port ▸n. Computing a connector by which a device that sends data one bit at a time may be connected to a computer.

seriate /ˈsirēˌāt/ technical ▸adj. arranged or occurring in one or more series. ▸v. [trans.] arrange (items) in a sequence according to prescribed criteria. —**seriation** /ˌsirēˈāshən/ n.

seriatim /ˌsirēˈātəm; -ˈāt͡səm/ ▸adv. formal taking one subject after another in regular order; point by point: *it is proposed to deal with these matters seriatim*.

sericulture /ˈseriˌkəlCHər/ ▸n. the production of silk and the rearing of silkworms for this purpose. —**sericultural** /ˌseriˈkəlCHərəl/ adj.; **sericulturist** /ˌseriˈkəlCHərist/ n.

seriema /ˌserēˈemə; -ˈāmə/ ▸n. a large, ground-dwelling South American bird (family Cariamidae) related to the bustards, with a long neck and legs and a crest above the bill.

series /ˈsirēz/ ▸n. (pl. same) a number of things, events, or people of a similar kind or related nature coming one after another: *a series of lectures*. ■ [usu. with adj.] a set of related television or radio programs, esp. of a specified kind: *a new drama series*. ■ a set of books, maps, periodicals, or other documents published in a common format or under a common title. ■ a set of games played between two teams. See also WORLD SERIES. ■ a line of products, esp. vehicles or machines, sharing features of design or assembly and marketed with a separate number from other lines: [as adj.] *a series III SWB Land Rover*. ■ a set of stamps, banknotes, or coins issued at a particular time or having a common design or theme. ■ [as adj.] denoting electrical circuits or components arranged so that the current passes through each successively. The opposite of PARALLEL. ■ Geology (in chronostratigraphy) a range of strata corresponding to an epoch in time, being a subdivision of a system and itself subdivided into stages. ■ Chemistry a set of elements with common properties or of compounds related in composition or structure. ■ Mathematics a set of quantities constituting a progression or having the several values determined by a common relation. ■ Phonetics a group of speech sounds having at least one phonetic feature in common but distinguished in other respects. ■ Music another term for TONE ROW.

PHRASES **in series** (of a set of batteries or electrical components) arranged so that the current passes through each successively.

serif /ˈserəf/ ▸n. a slight projection finishing off a stroke of a letter, as in T contrasted with T. See illustration at FONT². —**serriffed** adj.

serigraph /ˈseriˌgraf/ ▸n. a printed design produced by means of a silkscreen. —**serigrapher** /səˈrigrəfər/ n.; **serigraphy** /səˈrigrəfē/ n.

serin /ˈserən/ ▸n. a small Eurasian and North African finch (genus *Serinus*) related to the canary, with a short bill and typically streaky plumage.

serine /ˈserēn; ˈsi-/ ▸n. Biochemistry a hydrophilic amino acid, $CH_2OHCHNH_2COOH$, that is a constituent of most proteins.

serio•com•ic /ˌsirē-ōˈkämik/ ▸adj. combining the serious and the comic; serious in intention but jocular in manner or vice versa. —**serio•com•i•cal•ly** /-ik(ə)lē/ adv.

serious /ˈsirēəs/ ▸adj. 1 (of a person) solemn or thoughtful in character or manner. ■ (of a subject, state, or activity) demanding careful consideration or application: *marriage is a serious matter*. ■ (of thought or discussion) careful or profound: *serious consideration*. ■ (of music, literature, or other art forms) requiring deep reflection and inviting a considered response. 2 acting or speaking sincerely and in earnest, rather than in a joking or halfhearted manner. 3 significant or worrying because of possible danger or risk; not slight or negligible: *serious injury*. 4 [attrib.] informal substantial in terms of size, number, or quality: *he suddenly had serious money to spend*. —**seriousness** n.; **seriously** adv.

serjeant-at-arms ▸n. British spelling of SERGEANT-AT-ARMS.

serjeant-at-law ▸n. (pl. **serjeants-at-law**) Brit., historical a barrister of the highest rank.

serjeanty /ˈsärjəntē/ ▸n. (pl. **-ties**) Brit., historical a form of feudal tenure conditional on rendering some specified personal service to the monarch.

sermon /ˈsərmən/ ▸n. a talk on a religious or moral subject, esp. one given during a church service and based on a passage from the Bible. ■ a printed transcript of such a talk. ■ informal a long or tedious piece of admonition or reproof; a lecture. —**sermonic** /sərˈmänik/ adj.

sermonette /ˌsərməˈnet/ ▸n. a short sermon.

sermonize /ˈsərməˌnīz/ ▸v. [intrans.] compose or deliver a sermon. ■ deliver an opinionated and dogmatic talk to someone. —**sermonizer** n.

Sermon on the Mount ▸n. the discourse of Jesus recorded in Matt. 5–7, including the Beatitudes and the Lord's Prayer.

sero- ▸comb. form relating to serum: *serotype*. ■ involving a serous membrane: *serositis*.

seroconvert /ˌsirōkənˈvərt/ ▸v. [intrans.] Medicine (of a person) undergo a change from a seronegative to a seropositive condition. —**seroconversion** /-ˈvərzhən/ n.

serology /siˈräləjē/ ▸n. the scientific study or diagnostic examination of blood serum, esp. with regard to the response of the immune system to pathogens or introduced substances. —**serologic** /ˌsirəˈläjik/ adj.; **serological** /ˌsirəˈläjikəl/ adj.; **serologically** /ˌsirəˈläjik(ə)lē/ adv.; **serologist** /-jist/ n.

seronegative /ˌsirōˈnegitiv/ ▸adj. Medicine giving a negative result in a test of blood serum, e.g., for the presence of a virus. —**seronegativity** /-ˌnegəˈtivitē/ n.

seropositive /ˌsirōˈpäzitiv/ ▸adj. Medicine giving a positive result in a test of blood serum, e.g., for the presence of a virus. —**seropositivity** /-ˌpäziˈtivitē/ n.

serosa /səˈrōsə/ ▸n. Physiology the tissue of a serous membrane. —**serosal** adj.

serotine /ˈserətin; -ˌtīn/ ▸n. a medium-sized insectivorous bat (family Vespertilionidae), esp. a chiefly Eurasian bat (genus *Eptesicus*) and an African bat (genus *Pipistrellus*).

serotonin /ˌserəˈtōnən; ˌsir-/ ▸n. Biochemistry a compound, $C_{10}H_{12}N_2O$, present in blood platelets and serum that constricts the blood vessels and acts as a neurotransmitter.

serotype /ˈsirəˌtīp; ˈser-/ Microbiology ▸n. a serologically distinguishable strain of a microorganism. ▸v. [trans.] assign (a microorganism) to a particular serotype. —**serotypic** /ˌsirəˈtipik; ˌserə-/ adj.

serous /ˈsirəs/ ▸adj. Physiology of, resembling, or producing serum. —**serosity** /səˈräsitē/ n.

serous membrane ▸n. a mesothelial tissue that lines certain internal cavities of the body, forming a smooth, transparent, two-layered membrane lubricated by a fluid derived from serum. The peritoneum, pericardium, and pleura are serous membranes.

serow /səˈrō; ˈserō/ ▸n. a goat-antelope (genus *Capricornis*) with short sharp horns, long coarse hair, and a beard, native to forested mountain slopes of Southeast Asia, Taiwan, and Japan.

Serpens /ˈsərpənz/ Astronomy a large constellation (the Serpent) on the celestial equator, said to represent the snake coiled around Ophiuchus. It is divided into two parts by Ophiuchus, **Serpens Caput** (the "head") and **Serpens Cauda** (the "tail").

serpent /ˈsərpənt/ ▸n. 1 chiefly poetic/literary a large snake. ■ (**the Serpent**) a biblical name for Satan (see Gen. 3, Rev. 20). ■ a dragon or other mythical snakelike reptile. ■ figurative a sly or treacherous person, esp. one who exploits a position of trust in order to betray it. 2 historical a bass wind instrument made of leather-covered wood in three U-shaped turns, with a cup-shaped mouthpiece and few keys. It was played in military and church bands from the 17th to 19th centuries.

serpentine /ˈsərpənˌtēn; -ˌtīn/ ▸adj. of or like a serpent or snake: *serpentine coils*. ■ winding and twisting like a snake. ■ complex,

See page xxii for the Key to the pronunciations

CERTIFICATE OF SERVICE

I, Andrew A. Lundgren, Esquire, hereby certify that on August 11, 2008, I caused to be electronically filed a true and correct copy of the foregoing document with the Clerk of the Court using CM/ECF, which will send notification that such filing is available for viewing and downloading to the following counsel of record:

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